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*Markedness conflation in Optimality Theory**

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Markedness distinctions can be ignored. For example, in some languages stress avoids central vowels to fall on high peripheral vowels; yet in the Uralic language Nganasan central and high peripheral vowels are treated in the same way: stress avoids both types equally. Such 'conflation' of markedness categories is not only language-specific, but also phenomenon-specific. In contrast, dominance relations in markedness hierarchies are universal; e.g. stress never seeks out a central vowel when a high peripheral vowel is available. This article argues that both language-specific conflation and universal markedness relations can be expressed in Optimality Theory. Constraints referring to markedness hierarchies must be freely rankable and mention a contiguous range of the hierarchy, including the most marked element. The empirical focus is sonority-driven stress in Nganasan and Kiriwina. In addition, Prince & Smolensky's (1993) fixed ranking theory of markedness hierarchies is shown to be unable to produce the full range of attested conflations.

1 Introduction

This paper advocates a fundamental revision to the way that markedness hierarchies (such as the sonority hierarchy) are expressed formally in Optimality Theory, building on work by Prince (1997a, b, c, 1998, 1999). Related work is also found in Green (1993), Kiparsky (1994) and de Lacy (1997, 2000, 2002a). Following Prince, it argues that constraints that refer to markedness hierarchies must (a) be freely rankable and (b) refer to contiguous ranges of the hierarchy, starting with the most marked element. This approach contrasts with Prince & Smolensky's (1993) fixed ranking theory of hierarchies, which employs constraints that refer to elements in a hierarchy in a universally invariant ranking. The Fixed ranking theory will be shown to be overly restrictive: it fails to

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account for the full range of attested hierarchy-referring processes; the approach advocated herein is therefore less restrictive, due to empirical necessity.

A key issue in distinguishing the two approaches is that languages may ignore or 'conflate' markedness distinctions for particular processes. Such 'markedness conflation' is illustrated by the stress system of Nganasan. The position of main stress in Nganasan is optionally influenced by segmental sonority; the vowel-sonority hierarchy is given in (1), after Prince & Smolensky (1993), Kenstowicz (1997) and others (see especially §5.1 for discussion). (In (1) and elsewhere, '*a*', '*e*•*o*', '*i*•*u*', '*ə*' and '*ɨ*' will be used as abbreviations for the categories identified above. Of course, many more vowels belong to the categories than the abbreviations suggest: e.g. 'high peripheral vowels' includes [y ɯ] as well as [i u].)

(1) *Vowel-sonority hierarchy*

low peripheral	〉	mid peripheral	〉	high peripheral	〉	mid central	〉	high central
'*a*'		'*e*•*o*'		'*i*•*u*'		'*ə*'		'*ɨ*'

While the default position for stress is the penult (2a), stress will fall on the antepenult if it contains a more sonorous vowel (2b, c). The stress description is drawn from Helimski (1998), with additional data from Eugene Helimski (personal communication), Olga Vaysman (personal communication), Castrén (1854), Prokof'ev (1937), Hajdú (1964), Tereshchenko (1979) and Lublinskaya *et al.* (2000). A more complete data set for Nganasan stress is provided in §3.1.

(2) *Nganasan stress in brief*

a. *Default stress on penult*

[abáʔa]	'older sister, aunt'	[imíɟi]	'grandmother'
[əmkə́tə]	'from here'	[munúɟa]	'say'
[bɨnɨ́msɨ]	'feel thirsty'	[binýʃa]	'crumple'

b. *Stress optionally falls on antepenultimate* [a e o] *if penult is* [i y u ə ɨ] (*forms with antepenultimate stress are shown here; each word has a variant with penultimate stress*)

[ɟémbiʔʃi]	'dressing'	[négyʃa]	'tease'
[sóllətu]	'glass'	[hótəɟa]	'decorate, write'
[ániʔə]	'large'	[báruʃi]	'devil'

Nganasan reflects the universal nature of the relation between stress and sonority: when stress is influenced by sonority, stress seeks out higher-sonority vowels in preference to lower-sonority ones (see §5.1, Kenstowicz 1997, de Lacy 2002a: chs. 3, 4).

However, stress does not seek out more sonorous vowels in two situations in Nganasan. One is when the penult contains a central vowel [ɨ ə] and the antepenult contains a high peripheral vowel [i y u].[1] In such words, stress never retracts from the less sonorous penult central vowel to the more sonorous high peripheral vowel: e.g. [cintə́ɟi] 'stoke', *[cíntəɟi]; [kunsɨ́nɨ] 'inside', *[kúnsɨnɨ]. Of course, there is ample evidence from other cases of sonority-driven stress (see §5, Kenstowicz 1997, de Lacy 2002a) and from vowel reduction (Crosswhite 1999) that high peripheral vowels are more sonorous than central vowels. So Nganasan ignores or 'conflates' the sonority distinction between high peripheral and central vowels: in a sense both types are treated as 'equally sonorous', with stress falling on the default penult position. A similar point can be made for the difference between mid [e o] and low [a] peripheral vowels: again the distinction is conflated for stress purposes (e.g. [nacéɟuʔ] 'hang down, stick out', *[náceɟuʔ]).

At this point it is important to observe that there is evidence for each of the vowel-sonority distinctions: every distinction in (1) is exploited by some sonority-driven stress system. With a universal constraint set, it is therefore essential to have a set of constraints that can distinguish each of the vowel-sonority categories. In fact, evidence for the distinctions can be found in the case studies discussed in this article and in the typology of §5.

The aim of this paper is to identify a theory that allows distinctions between categories to be conflated. The theory advocates optimality-theoretic constraints that refer to contiguous ranges of a hierarchy starting with the most marked element. The constraints in (3) illustrate this point for sonority-driven stress, based on the vowel-sonority hierarchy in (1); for the sake of brevity, sonority categories will be referred to by a designated IPA symbol, as shown in (1). Kenstowicz's (1997) insight that sonority-driven stress involves regulating the relation between foot heads, non-heads and sonority is adopted here. So the vowel-sonority hierarchy in (1) is combined with the positions foot head (Hd_{Ft}) and foot non-head (non-Hd_{Ft}) to produce the constraints in (3) (see §2 for formal definitions of 'hierarchy' and the constraints below). After Prince's terminology, the constraints will be called the 'Stringency Hierarchy sonority constraints' here.

(3) *Stringency Hierarchy sonority constraints*

a. *HD$_{\text{Ft}}$/*ɨ*	b. *NON-HD$_{\text{Ft}}$/*a*
*HD$_{\text{Ft}}$/*ɨ,ə*	*NON-HD$_{\text{Ft}}$/*a,e•o*
*HD$_{\text{Ft}}$/*ɨ,ə,i•u*	*NON-HD$_{\text{Ft}}$/*a,e•o,i•u*
*HD$_{\text{Ft}}$/*ɨ,ə,i•u,e•o*	*NON-HD$_{\text{Ft}}$/*a,e•o,i•u,ə*
*HD$_{\text{Ft}}$/*ɨ,ə,i•u,e•o,a*	*NON-HD$_{\text{Ft}}$/*a,e•o,i•u,ə,ɨ*

[1] I use the term 'central vowel' throughout to refer to those vowels arrayed along the central horizontal line in the IPA vowel chart: [ɨ ʉ ɘ ɵ ə ɜ ɞ ɐ]. I exclude [a], which is located at the front of the vowel space (and is phonologically one of the most sonorous vowels). However, [a] may well be phonologically central (or unspecified for backness), and [ɐ] may be as sonorous as non-central vowels. These issues do not prove significant in this article, so I leave them aside here.

As an example, the constraint $*\text{HD}_{\text{Ft}}/ɨ,ə,i{\cdot}u$ is violated if a foot head contains either a central vowel or a high peripheral vowel. The constraints in (3) can be ranked freely: for example, while $*\text{HD}_{\text{Ft}}/ɨ,ə$ may outrank $*\text{HD}_{\text{Ft}}/ɨ,ə,i{\cdot}u$ in one language, the opposite ranking may hold in another.

The constraints in (3) capture both the universal and language-specific nature of the stress–sonority relation. On the universal side, they capture the fact that stress never seeks out a lower-sonority vowel in preference to a higher-sonority one (i.e. there is no 'anti-Nganasan' language, where stress avoids [a], preferring [ə]). The constraints produce this generalisation by cumulatively favouring higher-sonority stressed vowels over lower-sonority ones. For example, there is no constraint that favours some less sonorous vowel over [á] in (3a), while there are constraints that favour [á] over less sonorous vowels; similarly, every constraint that stressed mid peripheral vowels violate (i.e. $*\text{HD}_{\text{Ft}}/ɨ,ə,i{\cdot}u,ə,e{\cdot}o$) is also violated by every less sonorous stressed vowel.

On the language-specific side, the constraints in (3) allow conflation. For example, if only the constraint $*\text{HD}_{\text{Ft}}/ɨ,ə,i{\cdot}u$ is active in a language (i.e. no other $*\text{HD}_{\text{Ft}}/x$ constraint is significant in selecting the winner), the language will make no distinction between central and high peripheral vowels for stress purposes as they all incur the same violations of this constraint (see §3 for further discussion).

The main alternative to the theory summarised in (3) is the 'fixed ranking' theory of Prince & Smolensky (1993). In the fixed ranking theory, constraints refer to points on a hierarchy and are in a universally invariant ranking, as in Kenstowicz's (1997) sonority-feet constraints $*\text{HD}_{\text{Ft}}/ə \gg *\text{HD}_{\text{Ft}}/\text{i,u} \gg *\text{HD}_{\text{Ft}}/\text{e,o} \gg *\text{HD}_{\text{Ft}}/\text{a}$. In contrast, the constraints in (3) are not in a universally fixed ranking – their ranking may differ from language to language. In addition, they refer to ranges of a hierarchy.

This paper will show that the fixed ranking and stringency approaches differ in terms of their predictions for conflation. In many cases, the two theories are indistinguishable: often a conflation that poses difficulties for one set of fixed ranking constraints can be produced using another (often complementarily formulated) set (see §3.5.2 for discussion). Even so, the theories differ in two significant instances. Focusing on sonority-driven stress, constraints on sonority in a fixed ranking cannot produce stress systems where there are two or more sets of conflated sonority categories (see also Prince 1999: 11); this situation is found in Nganasan, discussed in §3. The other situation, illustrated in §4 through sonority-driven stress in Kiriwina, involves conflation in foot non-heads. More generally, it relates to conflation of a hierarchy H in a position P, when there are no constraints that refer to the complement of P and H's elements in a reverse manner. In short, the fixed ranking theory will be shown to be overly restrictive.

§2 presents the theoretical apparatus. §3 illustrates the theory through an analysis of Nganasan's stress system, showing how the $*\text{HD}_{\text{Ft}}/x$ constraints account for conflation. §4 focuses on the $*\text{NON-HD}_{\text{Ft}}/x$ constraints, showing their necessity in accounting for stress in the Papuan language

Kiriwina. The fixed ranking approach is discussed at relevant points in §§3 and 4. §5 identifies the typological predictions of the proposal. §6 presents conclusions.

2 Theory

The aim of this section is to present mechanisms that express markedness hierarchies in Optimality Theory. As in Prince's work, the leading ideas are that constraints that refer to such hierarchies are (a) freely rankable and (b) refer to ranges of a hierarchy rather than individual elements. As shown below, these properties are essential in expressing the implicational relations of a hierarchy while allowing the possibility of conflation.

As mentioned above, the proposals in this section – and specifically the way in which constraints assign violations – relate closely to Prince's proposals. In contrast, the formalism for expressing hierarchy-related constraints is different from Prince's; it instead has links to Green's (1993) proposals.

When constraints like *HD$_{Ft}$/*ɨ,ə* and *HD$_{Ft}$/*ɨ* are compared, *HD$_{Ft}$/*ɨ,ə* is seen to be more stringent (i.e. 'stricter') than *HD$_{Ft}$/*ɨ*, in that the former constraint rules out everything the latter constraint rules out, and more. In fact, many constraints that are not (obviously) derived by the same mechanism from the same hierarchy can be stringently related (e.g. *COMPLEXCODA and NOCODA, *VOWEL and *HD$_{Ft}$/*ɨ*); however, the discussion below is only about stringency as it applies to markedness hierarchies. It will therefore be called the Stringency Hierarchy theory.

Before moving on, it is necessary to clarify some terminology. The term 'markedness hierarchy', or 'hierarchy' for short, is used here to refer to an ordered collection of phonologically definable elements (or for syntactically related hierarchies, an ordered collection of syntactically definable elements). Such collections have formal status in the phonological component insofar as certain mechanisms can refer to them in constraint form. For example, the vowel-sonority scale in (1) is a hierarchy – a formal object that encodes an ordering relation '$\rangle$' between phonetically definable elements (i.e. vowel types, in this instance).

The ordering relation '$\rangle$' in hierarchies is transitive and asymmetric; '$\alpha \rangle \beta$' is read 'α is more marked than β'. However, the term 'markedness' will be used here to refer to a more 'surface-oriented' relation between elements, namely the relations established between members of a hierarchy through constraint violation in terms of a certain set of constraints. For example, the vowel-sonority hierarchy will be used in two constraint series below: one for foot heads and one for foot non-heads. In the foot head series, [ɨ] in head position incurs a superset of violations of the *HD$_{Ft}$/x constraints when compared to all more sonorous vowel types on the scale; in this sense, [ɨ] is 'more marked' than all other vowel types in head position in terms of the $^*\textsc{Hd}_{Ft}/x$ constraints. In contrast, [ɨ] is less marked than all other vowels in non-head position in terms of the $^*\textsc{Non-Hd}_{Ft}/x$ constraints.

To make one thing clear from the outset, the proposals start from the assumption that hierarchies exist and are accessible to constraint-generation mechanisms. The hierarchies' origin – whether learned or innate – is irrelevant to their expression as constraints, so the issue will not be addressed here.

The formal expression of hierarchies is discussed in §2.1. §2.2 discusses the relation between hierarchies and constraints that refer to hierarchies. §2.3 discusses such constraints' violation profiles. Finally §2.4 discusses the use of multivalued features.

2.1 Feature values

This section proposes that hierarchies are formally expressed by means of multivalued features, relating to proposals by Liberman (1975), Steriade (1982), Prince (1983), Selkirk (1984), Green (1993), Gnanadesikan (1997) and others.

The proposal is that for every hierarchy there is an equivalent feature, and the elements on that hierarchy are expressed as feature values. This approach will be called the '*xo* theory', as feature values are a string of *x*'s and *o*'s (also see Green 1993). The length of a feature-value string is one less than the number of elements on the corresponding hierarchy. So, in effect every value shows the extent of a hierarchy – a hierarchy of n distinctions has values of length $n-1$. For example, the feature [nasal] has two values, traditionally [+nasal] and [–nasal], so the present approach represents the distinction as [*x* nasal] and [*o* nasal]. For ternary features, such as Gnanadesikan's (1997) consonantal stricture, a string of length 2 is used, distinguishing *xx*, *xo* and *oo* values.

In identifying a mechanism for expressing constraints that refer to hierarchies, the first step is to identify a mechanism for relating hierarchies to multivalued features, as in (4).

(4) *Hierarchy to feature conversion*

For a hierarchy $H = |\alpha \rangle \beta \rangle \ldots \gamma|$

a. there is a phonological feature [H]
b. [H]'s value is a string of length $n-1$, where n is the number of elements in H.
c. For a value v, [v H] refers to an element E in H such that
   for every distinct element F in H such that F $\rangle$ E
   there is a distinct o in v.
   The remaining elements in v are x's.

As an example, the vowel-sonority hierarchy in (1) is expressed as a feature [sonority] with the values in (5).

(5) *Multivalued sonority features*

[*xxxx* sonority]	low vowels
[*xxxo* sonority]	mid peripheral vowels
[*xxoo* sonority]	high peripheral vowels
[*xooo* sonority]	mid central vowels
[*oooo* sonority]	high central vowels

To elaborate, the feature that refers to mid peripheral vowels [*xxxo* sonority] has one *o*, because there is one element that 'outranks' mid peripheral vowels on the sonority hierarchy – i.e. low vowels. The value is four *x*/*o*'s long because there are five elements on the hierarchy.

[sonority] behaves like any other feature. It is part of the featural make-up of segments, and has a phonetic interpretation (for theories of the phonetic interpretation of sonority, see Parker 2002 and references cited therein).

The *xo* theory can be used to easily capture relative 'markedness'. Analogous to grid theory, an element A is 'more sonorous' than B if A's value for [sonority] contains more *x*'s than B's. This notion of string inclusion will prove useful below in defining constraints referring to hierarchies.

The *xo* approach does bear some relation to using integers for feature values (see §2.4, Chomsky & Halle 1968, Ladefoged 1975). However, the *xo* approach cannot be straightforwardly replaced by an integer approach. One important difference is that the *xo* approach specifies the range of values for an individual feature, thus [*xoo*] is equivalent to 'value 1 of 3 possible *x* values'. The other difference is that the *xo* approach allows easy reference to both the value of a feature and its complementary value – i.e. to both the *x*'s and the *o*'s. This is crucial when dealing with *HD$_{\text{Ft}}$ constraints, which refer to *x*'s, and *NON-HD$_{\text{Ft}}$ constraints, which refer to *o*'s. In contrast, there is no straightforward way to deal with this using integers. As will be seen below, the only type of reference allowed to constraints when it comes to *x*'s and *o*'s is one of identity – i.e. whether two segments have the same number of *x*'s and *o*'s for a particular feature – or containment – whether one segment's string of *x* values contains another segment's *x* string for some feature (and likewise for *o*'s). In this way, the *xo* approach is very limited.

§§2.2 and 2.3 will assume multivalued features without comment. §2.4 discusses the consequences of using multivalued features.

2.2 Constraint form

Hierarchies differ in terms of how constraints relate them to structural positions. For example, constraints relating to the place of articulation hierarchy can refer to places of articulation alone (e.g. *dorsal, *labial; Lombardi 2001, de Lacy 2002a: chs. 6–8). In contrast, constraints that have been proposed to refer to the sonority hierarchy also refer to structural positions; examples include Prince & Smolensky's (1993) syllable-sonority constraints and Kenstowicz's (1997) foot-sonority constraints (also see Zec 2000 and de Lacy 2002a for theories of reference to structural positions).

Unfortunately, providing a theory about which hierarchies can and must combine with structural positions in constraints is beyond the scope of this article (see de Lacy 2002a: §2.4 for relevant proposals). As this paper focuses on the sonority hierarchy and how it relates to foot heads and non-heads, this section will concentrate on the construction procedure for constraints that combine structural elements and hierarchies like sonority.

Generalising proposals from previous work on sonority, there are constraints that combine heads of constituents with the sonority hierarchy, and constraints that combine non-heads. For example, Kenstowicz (1997) proposes constraints that refer to foot heads *vs.* foot non-heads, Prince & Smolensky (1993) propose constraints that refer to nuclei *vs.* onsets (e.g. heads of syllables *vs.* non-heads) and de Lacy (2002a) proposes constraints that refer to head syllables of Prosodic Words (i.e. main-stressed syllables) and non-head syllables. The two series treat different ends of the sonority hierarchy differently, as defined below.

(6) *The form of context-sensitive hierarchy constraints*

a. H is a hierarchy that must combine with a structural element in constraint form.

b. [H] is the feature derived from H.

c. For every feature value v of [H], there are constraints for every value of α (where α is a prosodic constituent) such that:

i. *HD_{α}/v_2, where v_2 contains all and only the *o* values in v;

ii. *$\text{NON-HD}_{\alpha}/v_3$, where v_3 contains all and only the *x* values in v.

To illustrate (6), the constraints generated by combining the vowel-sonority hierarchy in (1) with the category Ft will be given below (also see Kenstowicz 1997). The category 'foot head' refers to the 'head' or 'strong' syllable of a foot – namely the syllable on which stress is realised. The category 'foot non-head' refers to the 'weak' syllable in a foot; it will prove significant that 'foot non-head' does not refer to unfooted syllables. The foot-sonority constraints are given in (7).[2]

(7) *Foot-sonority constraints*

a. *HD_{Ft}/[*oooo* sonority]	b. *$\text{NON-HD}_{\text{Ft}}$/[*xxxx* sonority]
*HD_{Ft}/[*ooo* sonority]	*$\text{NON-HD}_{\text{Ft}}$/[*xxx* sonority]

[2] Only the sonority of vowels is considered here, because the case studies in this article do not provide evidence for the relation of stress to consonant sonority. However, such constraints may (and most probably do) refer to consonant sonority; in this regard, relevant cases may be those in which syllables with coda consonants attract stress only when those codas are highly sonorous (e.g. nasals, liquids). Cases in which syllables with consonantal nuclei avoid stress may also prove relevant.

*HD$_{Ft}$/[*oo* sonority]	*NON-HD$_{Ft}$/[*xx* sonority]
*HD$_{Ft}$/[*o* sonority]	*NON-HD$_{Ft}$/[*x* sonority]
*HD$_{Ft}$/[sonority]	*NON-HD$_{Ft}$/[sonority]

The interpretation of these constraints is given schematically in (8).

(8) a. *HD$_{\alpha}$/v
Assign a violation for every segment in Hd$_{\alpha}$ that is [wF], where v is a substring of w.

b. *NON-HD$_{\alpha}$/v
Assign a violation for every segment in non-Hd$_{\alpha}$ that is (wF], where v is a substring of w.

For example, *HD$_{Ft}$/[*oo* sonority] is violated once for every segment in the head syllable of a foot that has *oo* in its [sonority] value: i.e. high peripheral, mid central and high central vowels.

To make the form of the foot-sonority constraints more transparent, the [sonority] values will, as noted above, be replaced with abbreviations for sonority categories in the rest of this article; in other words, '*ɨ*' stands for high central, '*ə*' for mid central, '*i•u*' for high peripheral, '*e•o*' for mid peripheral and '*a*' for low vowels. The constraints in this abbreviated form are listed in (3) above.

2.3 Stringency

The constraints in (3) express the hierarchical relations in the sonority hierarchy through cumulative violation assignment: the more 'marked' an element is (relative to its position), the more violations of the constraints it incurs in total. Quasi-tableau (9) illustrates this point with a subset of the head foot-sonority constraints.

(9)

	*HD$_{Ft}$/*ɨ*	*HD$_{Ft}$/*ɨ,ə*	*HD$_{Ft}$/*ɨ,ə,i•u*	*HD$_{Ft}$/*ɨ,ə,i•u,e•o*	*HD$_{Ft}$/*ɨ,ə,i•u,e•o,a*
a. ɨ́	*	*	*	*	*
b. ə́		*	*	*	*
c. ú			*	*	*
d. é				*	*
e. á					*

In quasi-tableau (9), the most marked foot head element [ɨ́] incurs a superset of the other candidates' violations. Therefore, [ɨ́] will always be the least preferred, no matter what the ranking of the constraints.[3]

[3] The situation presented above is a type of harmonic bounding. A candidate α is a harmonic bound for β if α incurs a proper subset of β's violations (Samek-Lodovici 1992, Prince & Smolensky 1993: ch. 9, McCarthy 2002: §1.3.1). In such a situation, no grammar will ever output β since α will always be more harmonic than it. Prince

In contrast, [á] incurs a proper subset of the violations of the other elements. Since there is no constraint for which any non-low vowel incurs fewer violations than [á], there is no ranking in which [á] can lose in relation to these constraints. The net result is that the constraints express relative markedness universally: in every grammar, the constraints favour [á] over all other vowels, and [ə́] over [ɨ́], while not favouring [ɨ́] at all. This result follows from the stringency relation seen in the elements' violation marks, hence the name 'Stringency Hierarchy constraints' used here.

To account for universality while having freely rankable constraints, it is necessary that the constraints refer to contiguous ranges of a hierarchy, starting with the most marked element. If the constraints instead referred to individual points on a hierarchy (e.g. *Hᴅ$_{\mathrm{Ft}}$/ɨ, *Hᴅ$_{\mathrm{Ft}}$/ə, *Hᴅ$_{\mathrm{Ft}}$/i,u, ...) and were freely rankable, there would be no way to capture markedness relations between the segments. For example, the ranking *Hᴅ$_{\mathrm{Ft}}$/ə $\gg$ *Hᴅ$_{\mathrm{Ft}}$/i,u would result in stressed high peripheral vowels being avoided less than stressed [ə] and [ɨ], while the ranking *Hᴅ$_{\mathrm{Ft}}$/i,u $\gg$ *Hᴅ$_{\mathrm{Ft}}$/ə would have the opposite effect. Therefore, reference to ranges of a hierarchy is necessary with freely rankable constraints.

Free ranking between the constraints is necessary to account for conflation. Two categories are conflated if they incur equal violations of active constraints; this point will be developed in §3.4.

2.4 Multivalued and binary features

Two ways in which the stringency proposal differs from traditional approaches to hierarchies (especially the fixed ranking theory) are (i) the absence of fixed rankings, and (ii) the use of multivalued features. The first difference is central to the proposal made in this paper, and as such will be discussed in detail in subsequent sections. The latter difference will be less central to the argumentation developed in subsequent sections, but is nonetheless a necessary element of the proposed theory, and is therefore briefly discussed below.

The proposal that hierarchies correspond to multivalued features has a number of implications. One is that hierarchies should 'act' like other features (e.g. [voice], [nasal], place of articulation) in defining natural classes for processes like assimilation, harmony, dissimilation and so on. The natural class issue will be discussed for [sonority] in §3.6.2; it cannot be discussed here as pertinent data is presented later, in §§3.1–3.5. §3.6.2 will also argue that [sonority] cannot be expressed as a set of binary

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& Smolensky (1993: ch. 9) show that harmonic bounding reduces to properties of the mark-cancellation procedure. If α has a subset of β's marks, then after mark cancellation β will still have violations while α does not, therefore dooming β to 'loser' status. Adopting terminology from Samek-Lodovici & Prince (1999), α is a harmonic bound for β if no constraint 'favours' β over α and some constraint favours α over β. A constraint C favours α over β if α incurs fewer violations of C than β does.

features. The aim of this section is instead to examine the general idea that there are multivalued features.

The proposal that there are multivalued features is somewhat non-standard, given the dominance of binary (two-valued) and privative (one-valued) features in a great deal of previous and current work (Jakobson *et al.* 1951, Jakobson & Halle 1956, Chomsky & Halle 1968, Creider 1986, Steriade 1995: 147–157). However, multivalued features are by no means novel. Chomsky & Halle (1968) employ a multivalued feature for stress, and a number of researchers have effectively proposed a multivalued [sonority] feature (Steriade 1982, van der Hulst 1984, Selkirk 1984, Durand 1990, Green 1993). Ladefoged (1975) and Williamson (1977) propose multivalued laryngeal features, and Stahlke (1975) and many others have proposed a multivalued feature for tone (e.g. Odden 1995). Gnanadesikan (1997) has argued that several features are ternary-valued. Clements' (1991) [open] feature can be 'stacked', effectively producing multiple distinctions in vowel height (see also Lindau 1978, Clements & Hume 1995). In other words, these theories have expanded the set of feature values to include many more distinct elements (usually represented by the natural numbers {0, 1, 2, ...}, for convenience).

The 'natural number' approach is only one way to allow multivalued features. Liberman (1975) and Prince's (1983) grid theories provide another method (see also Kiparsky 1979, Selkirk 1984, Hayes 1995: ch. 7). Instead of an *n*-valued [stress] feature, a string of *x*'s specifies relative stress among syllables or moras. The grid-theory approach to multivalued features has frequently been extended to other features: for example, it has been used for sonority, with gridmarks standing for different sonority levels (van der Hulst 1984, Milliken 1988, Zec 1988, Parker 1989, Clements 1990, 1992, Green 1993).[4]

A comprehensive discussion of whether multivalued features exist is beyond the scope of this paper. However, it is worth noting that those few works that explicitly compare the virtues of binary and multivalued features (Sommerstein 1977, Creider 1986, McCarthy 1988) agree with Creider's statement that 'there are surprisingly few phonological arguments [against multivalued features] in the literature'. In the most recent and detailed account, McCarthy (1988: 94) observes that arguments presented for one or the other approach are not based on empirically testable issues, but instead rely on appeals to theory-internal simplicity or ease of implementation (e.g. Chomsky & Halle's 1968 evaluation metric). McCarthy observes that objections to multivalued features often rest on the assumption that multivalued features automatically introduce the full power of arithmetic to the grammar, allowing features to be incremented or decremented by any number. Of course, the algorithms that manipulate

[4] Grid theory represents *relative* values for stress, sonority, etc. (see especially Selkirk 1984: 112, 121). In contrast, the usual conception of multivalued features is that they refer to absolute values. In some cases, the difference is difficult to discern. For example, while Gnanadesikan's (1995) ternary-valued features refer to absolute TQ1 values, the constraints that mention them effectively treat them as relative.

feature values are somewhat independent from the form of the features themselves. The same goes for the objection that there is no obvious limit to the number of distinctions allowed per feature; again the issue of the maximum number of distinctions per feature is entirely separate from the form of the features themselves. To relate this point to the present theory, the *xo* proposal does not introduce the full power of arithmetic operations commonly associated with integers.

Further discussion of this issue can be found in de Lacy (2002a: §2.3.1.1). For present purposes, it is enough to observe that no compelling phonological argument has been advanced to reject multivalued features in favour of binary/privative ones, or indeed to reject binary/privative features in favour of multivalued ones.[5]

3 Foot heads and double conflation in Nganasan heads

Distinguishing the fixed ranking and Stringency Hierarchy theories is not a simple matter. §3.5 will show that apparent problems faced by a set of constraints in a fixed ranking can often be overcome when other sets of fixed ranking constraints are considered (in particular, constraints on complementary structural positions – e.g. stressed *vs.* unstressed syllable). However, there are two ways in which the two theories are distinct. This section identifies one, showing that the Stringency Hierarchy approach correctly allows stress systems like Nganasan's – in which there are two or more sonority conflations – while the fixed ranking approach cannot (also see Prince 1999: 11). The second situation will be discussed in §4.

In more general terms, this section demonstrates how the stringency constraints produce conflation. An explanation is presented of why Nganasan stress is not sensitive to the distinction between low and mid peripheral vowels, on the one hand, or that between high peripheral vowels and central vowels, on the other. An additional aim is to show that while the constraints allow conflation, they do not allow markedness reversal – in other words, the constraints maintain the hierarchical relations between sonority categories.

§3.1 presents a description of Nganasan stress. §3.2 provides a ranking for 'default' foot construction in Nganasan and §3.3 shows the need for the *HD_{Ft}/*ɨ,ə,i·u* constraint. §§3.4 and 3.5 deal with conflation: §3.4 provides a stringency analysis of Nganasan, while §3.5 discusses a fixed ranking approach. §3.6 examines some alternative approaches that have (to some degree) been proposed previously. Some remaining aspects of the stress system of Nganasan that do not bear directly on the conflation issue are analysed in §3.7. A summary is given in §3.8.

[5] Chain shifts have been argued to provide evidence for multivalued features (e.g. Gnanadesikan 1997 and works cited therein), though Creider (1986) argues to the contrary.

3.1 Description

This section presents a description of stress in the Avam dialect of the Uralic language Nganasan. Nganasan is also known as Tawgi or Tawgi-Samoyed, and is the northernmost language spoken in Russia, on the Tamyr Peninsula in Siberia. The description presented here is from Helimski (1998, personal communication). It is supplemented by data from fieldwork by Castrén (1854), Prokof'ev (1937), Hajdú (1964), Tereshchenko (1979), Lublinskaya *et al.* (2000) and Olga Vaysman (personal communication). (10) lists the vowels of Nganasan vowels; every vowel has a long counterpart.[6]

(10) *Nganasan vowels*

i	y	ɨ	u
e		ə	o
		a	

Syllables have the shape (C)V(V)(C). Rhymes may contain a diphthong or a long vowel (e.g. [baːr.bə] 'master, chief', [bə.lou.kə] 'a kind of movable dwelling on runners'. The Nganasan consonants are [p t c k ʔ b d ɟ g ð s ʃ h m n ɲ ŋ l ʎ r j].

Putting the influence of vowel sonority aside momentarily, Nganasan has a fairly standard right-aligned trochaic stress pattern. Helimski (1998: 486) describes stress as falling on a final CVV syllable, and otherwise the penult, as illustrated in (11). Stress domains consist of a root and certain affixes; secondary stress falls on heavy syllables and every other light syllable preceding a stress (i.e. it is quantity-sensitive, trochaic and right-edge oriented – e.g. [(kìntə)(lə̀btɨ)(kútiŋ)] 'you are smoking'). Syllables with long vowels (CVː) are heavy, CVC and CV syllables are light. Stressed vowels are realised with longer duration and loudness than unstressed vowels (see §3.6.3 for details).

(11) *Nganasan default main stress*

a. *Main stress falls on a final heavy* (CVV) *syllable*

[kʲymáː]	'knife'	[kùʔbasáː]	'bead ADJ'
[carkíː]	'worn out'	[mə̀tyʔbíːʔ]	'sixty'
[bobəː]	'replacement'	[bìkaðə́ː]	'river'
[màːgə́ː]	'hard, firm'	[lỳkyðʲái]	'flower'
[hòrəðʲái]	'tree leaf'		

[6] There are some restrictions on vowels. For example, the front vowels do not appear in the first syllable after dentals. The mid vowel [o] only appears in non-initial syllables when flanked by labial sounds [b m], and non-initial [e] only occurs after palatals. Neither of these restrictions is significant for stress, so they will not be discussed further here. Helimski (1998) and Vaysman (2002, personal communication) differ as to whether Nganasan has palatalised coronals [tʲ dʲ sʲ nʲ lʲ] (Helimski) or alveo-palatals and palatals [c ɟ ʃ ɲ ʎ] (Vaysman); the latter approach is adopted here for convenience – the choice has no relevance for stress.

b. *Otherwise it falls on the penult*

[sə́mu]	'hat'	[kóruʔ]	'house'
[túgɨʔ]	'cloth'	[máŋkə]	'first cousin'
[hutáruʔ]	'of the houses'	[cimísi]	'gum'
[basáðaŋ]	'copper'	[abáʔa]	'older sister, aunt'
[cíːɟe]	'sleeve'	[báːrbə]	'master, chief'
[curáːɟa]	'ventilate'	[matáːlir]	'burial mound'
[bə.lóu.kə]	'dwelling on runners'	[maðáiʃa]	'stay as a guest'
[cìːtə́sa]	'hide'	[bàːgýðə]	'marine'

However, in trisyllabic words where all syllables are light (i.e. CV or CVC), stress can optionally fall on the antepenultimate syllable if it contains a non-high peripheral vowel [a e o] and the penult is a light syllable with a central or high peripheral vowel [i y u ə ɨ] (Helimski 1998: 486).[7] Relevant data is given in (12). Words that have more than three syllables or contain heavy syllables are discussed briefly below and in more detail in §3.7.

(12) *Nganasan antepenult stress in words with three light* (i.e. CV, CVC) *syllables*

a. *Stress antepenult* [e o] *if the penult is short* [i y u ə ɨ]

[ɟémbiʔʃi]	'dressing'	[négyʃa]	'tease'
[cétua]	'very much'	[hékutɨ]	'with quick temper'
[cétəmtɨ]	'fourth'	[négɨku]	'dirty'
[ŋónɟiʔə]	'going out'	[hóðyʔo]	'writing'
[kóntuɟa]	'carry'	[hótəɟa]	'decorate, write'
[sólətu]	'glass'		

b. *Stress antepenult* [a] *if the penult is short* [i y u ə ɨ]

[ániʔə]	'large'	[tánduɟə]	'wider (ATTRIB)'
[báruʃi]	'devil'	[bátyʔo]	'tail bone, back'
[kánəmtu]	'which (in order)'	[sʷáləmə]	'resinous'
[hʲásɨrə]	'fishing rod'		

A revealing set of alternations is found in comparing stress on the roots /korut/ 'house' with /hutar/ 'strap' with various suffixes. Tereshchenko (1979: 62) reports the alternations [húðar] (NOM SG), [hutár-əʔ] (NOM PL) and [hutár-uʔ] (GEN PL), so showing the preference for stress to fall on the penult. In contrast, stress remains on the first syllable in /korut/: [kóruʔ] (NOM SG), [kóruð-əʔ] (NOM PL), [kóruð-uʔ] (GEN PL); the reason for the lack

[7] Tereshchenko (1979: 41) states that stress on trisyllabic words is unpredictable; however, his data agrees closely with the description given here (e.g. [matáːlir], [horəðʲái]). His description also attests to the variability of stress reported by Helimski: [hékutɨ] and [sólətu] show sonority-driven retraction, while [cerə́ʔsi] does not. Otherwise, the majority of trisyllabic forms with the appropriate sonority shape in Tereshchenko's data show antepenultimate stress.

of penult stress in [kóruð-əʔ] and [kóruð-uʔ] is due to the [o] attracting stress away from the [u].

The Nganasan pattern shows that there is a distinction for stress purposes between [a e o] on the one hand and [i y u ə ɨ] on the other. Importantly, there are no distinctions within these sets. Stress never retracts from a penult [e o] onto a low vowel – the forms in (13a) never have antepenult stress. Similarly, stress never retracts from a central vowel onto a high vowel, so the words in with examples in (13b) are always stressed on the penult.

(13) a. *No stress retraction from mid to low vowels*

[bacébsa]	'breathing'	[kacéməʔ]	'examine'
[nacéɟuʔ]	'hang down, stick out'	[lʷamóbtuʔ]	'spill, splash'

b. *No stress retraction from central to high vowels*

[cintə́ɟi]	'stoke'	[ɲilɨ́ɟi]	'reside'
[cuhə́nu]	'during'	[kunsɨ́nɨ]	'inside'
[hytə́ðə]	'torso'		

Stress does not retract from a high peripheral vowel to a central vowel either: e.g. [nənsúɟi] 'stands up', *[nə́nsuɟi], [nə́ŋhuɟa] 'deteriorate', *[nəŋhúɟa], [təɲíni] 'there (LOC),*[tə́ɲini]'. The data in (13) also underscores the fact that central and high peripheral vowels are not 'unstressable'; additional examples include [ə́ʔə] 'older brother, uncle', [bɨ́nɨ] 'rope', [ətɨ́ə] 'duty', [múli] 'pattern', [múnsa] 'say', [myntýʃa] 'be full'.

To summarise, Nganasan has two conflations: it conflates mid and low peripheral vowels [a e o] for stress purposes, and high peripheral with central vowels [i y u ə ɨ].[8]

In informal terms, the stress description can be cast in terms of two interacting preference scales, one relating to sonority and the other to position. With regard to position, the foot clearly prefers to be aligned with the right edge of the word. With regard to sonority, the preference of stress for vowels with high sonority – i.e. [a e o] – can override the penult preference.

However, there are limits on sonority's influence: sonority cannot induce stress to fall on the final syllable (e.g. [kíta] 'cup', *[kitá]), nor can it attract stress away from a long vowel: e.g. [hontɨ́ːə] 'having (PARTICIPLE)', *[hóntɨːə], [mebkə́ːɟi] 'pinch', *[mébkəːɟi], [carkíː] 'worn out', *[cárkiː], [màːgə́ː] 'hard, firm', *[máːgə́ː]. In addition, while sonority affects words

[8] The Uralic language Moksha Mordvin has been reported as having the same conflation of vowel qualities as Nganasan (Paasonen 1938: 114–119, Kenstowicz 1997). However, Kenstowicz notes that crucial data is missing from published sources (i.e. words that show conflation of high vowels and schwa – [CəC{i u}]). Jack Reuter and Aleksandr Feokstitov (personal communication) report that words with this shape do not exist in the standard dialect, but appear in south-east dialects. In these dialects, there is some evidence that high vowels are not conflated with schwa: stress moves off the default initial position if there is a high vowel in the second syllable in Feokstitov's dialect: [pətí] 'put (3SG)'. Thus, at least one dialect of Moksha has the scale ə 〉 i,u 〉 e,o,a, without conflation of the schwa and high vowels.

with three light syllables, its effect is less pervasive in four-syllable words: e.g. [ŋàmʲacmə] 'nine' (less frequently [ŋamʲácymə]) (Eugene Helimski, personal communication).

§§3.2–3.4 discuss the influence of sonority on feet in Nganasan, with the aim of providing an analysis set within the Stringency Hierarchy theory and showing that the fixed ranking theory is inadequate. §§3.5 and 3.6 discuss alternative theories. §3.7 discusses stress in Nganasan words with more than three syllables and heavy syllables.

3.2 Default footing

Putting sonority aside momentarily, Nganasan's stress system clearly employs a right-aligned quantity-sensitive trochaic foot. Quantity-sensitivity is evident in words with final stressed heavy syllables (e.g. [kʲy(máː)], *[(kʲýmaː)]). Penultimate stress shows that the foot is left-headed (e.g. [(kó.ruʔ)]) and right-aligned (e.g. [ci(mísi)], *[(cími)si]).

A fairly standard analysis of this pattern is adopted here, using the constraints in (14) (McCarthy & Prince 1993a, b, Prince & Smolensky 1993).

(14) a. ALIGNFT-R
The right edge of every foot must be aligned with the right edge of a PrWd (McCarthy & Prince 1993a).

b. FTBIN-μ
Every foot is binary at the moraic level (after McCarthy & Prince 1986).

c. TROCHEE
Every foot is left-headed (i.e. ALIGN-L(Hd$_{Ft}$, Ft) – McCarthy & Prince 1993a).

The constraints' effect is illustrated in tableau (15).

(15) *Right-aligned trochees*

kuhumi	FTBIN-μ	TROCHEE	ALIGNFT-R
☞ a. ku(húmi)			
b. kuhu(mí)	*!		
c. ku(humí)		*!	
d. (kúhu)mi			*!

The constraints in (14) also ensure that final heavy syllables will be stressed: a form such as [kʲy(máː)] does not violate ALIGNFT-R, FTBIN-μ or TROCHEE, thereby beating ungrammatical alternatives.

A further ranking of FTBIN-$\mu \gg$ALIGNFT-R could be established at this point if it were assumed that ($\acute{\sigma}_{\mu\mu}\sigma_{\mu}$) trochees are banned, with the implication that [(báːr)bə)] beats *[(báːrbə)] and *[baːr(bə́)]. While HL feet are permitted in other languages (Kager 1993, Hayes 1995), Hayes argues that they are marginal, so I will assume that they are not permitted in Nganasan. Candidates which 'split' the vowel (e.g. [ba(árbə)] can be ruled out by constraints on syllable structure (e.g. ONSET). This ranking also bans trimoraic feet in antepenult-stress words like [(sólə)tu], *[(sólətu)]. Further evidence for the ranking FTBIN-$\mu \gg$ALIGNFT-R will be given below.

3.3 Sonority-driven stress

In Nganasan, stress retraction to the antepenultimate syllable for sonority reasons is in free variation with penultimate stress. However, Eugene Helimski (personal communication) reports that retraction is the prevalent pattern. The ranking which produces retraction is the focus of this section; the formal implementation of optionality will be discussed in §3.7.

Stress does not fall on a CV(C) penultimate syllable in trisyllabic words with all light syllables (i.e. CV or CVC) when two conditions are met: (i) the penult contains a high peripheral [i y u] or central [ə ɨ] vowel and (ii) the antepenult contains a non-high peripheral vowel [a e o]. In such a situation the foot 'retracts' from the right edge: e.g. [(sólə)tu], *[so(lə́tu)], [(báru)ʃi], *[ba(rúʃi)].

In order for stress to be sensitive to sonority, some Stringency Hierarchy *(NON-)HD$_{Ft}$/sonority constraint must outrank one of the metrical constraints in (14); this is the basic ranking needed for non-metrical stress (Kenstowicz 1997, de Lacy 2002b: §6). For Nganasan, the relevant constraint is *HD$_{Ft}$/*ɨ,ə,i·u*, which assigns a violation for every foot-head vowel if it is as sonorous as or less sonorous than a high peripheral vowel. Only the low and mid peripheral vowels [á é ó] do not violate this constraint, as shown in the tableaux in (16).

(16) *Foot retraction to* (*a*) *a low peripheral vowel;* (*b*) *a mid peripheral vowel*

a.	baruʃi	*HD$_{Ft}$/*ɨ,ə,i·u*	ALIGNFT-R
	☞ i. (báru)ʃi		*
	ii. ba(rúʃi)	*!	
b.	solətu		
	☞ i. (sólə)tu		*
	ii. so(lə́tu)	*!	

While the (b) candidates are most harmonic in terms of foot alignment, they fatally violate *HD$_{Ft}$/*ɨ,ə,i·u* by containing a stressed vowel with low sonority (i.e. [u ə]). In contrast, their competitors (a) contain a stressed low and mid vowel, so avoiding violations of *HD$_{Ft}$/*ɨ,ə,i·u*. Therefore, while the (a) candidates fare worse than the (b) candidates in terms of AlignFt-R, this violation is rendered irrelevant by the ranking.

While *Hd$_{\text{Ft}}$/*ɨ,ə,i·u* outranks AlignFt-R, it is not undominated. A word like [(kíta)] shows that stress will not move off the penult to a more sonorous vowel if doing so would violate either FtBin-*μ*, as in *[ki(tá)], or Trochee, as in [(kitá)]. Accordingly, FtBin-*μ* and Trochee both outrank *Hd$_{\text{Ft}}$/*ɨ,ə,i·u*.

(17) *No degenerate or iambic feet*

kita	Trochee	FtBin-*μ*	*Hd$_{\text{Ft}}$/*ɨ,ə,i·u*
☞ a. (kíta)			*
b. (kitá)	*!		
c. ki(tá)		*!	

FtBin-*μ*'s ranking also accounts for the fact that sonority considerations do not take precedence over stress on a long vowel: e.g. stress does not fall on the antepenult in [ŋonə́ːðə] 'once again', even though this would result in a more sonorous stressed vowel (e.g. *[ŋónəːðə]). If stress retracted to the antepenult, the foot would either have to be degenerate *[(ŋó)nəːðə] or trimoraic *[(ŋónəː)ðə]. Both options violate FtBin-*μ*, and are therefore blocked.

Faithfulness constraints must also outrank *Hd$_{\text{Ft}}$/*ɨ,ə,i·u* to avoid a possible response whereby the penult is changed into a low or mid vowel – e.g. /baruʃi/→*[ba(róʃi)]. To avoid this possibility in Nganasan, faithfulness constraints on vowel height and centrality features must outrank the *Hd$_{\text{Ft}}$/*x* constraints. As an additional note, it is not enough for the faithfulness constraints to outrank only AlignFt-R, in a ranking such as *Hd$_{\text{Ft}}$/*ɨ,ə,i·u* ≫ Ident[height,centrality] ≫ AlignFt-R. While such a ranking would correctly prefer [(sólə)tu] over *[so(létu)] and *[so(lə́tu)] from input /solətu/, it would incorrectly force the /ə/ in /səmu/ to become more sonorous (e.g. *[sému]). For examples of feature change driven by sonority-based constraints, see Crosswhite (1998, 1999) (for *Hd$_{\text{Ft}}$/*x* constraints especially 1999: §2.1.5), and de Lacy (2002a: ch. 4), specifically for *Non-Hd$_{\text{Ft}}$/*x* constraints.

The important rankings established for Nganasan stress so far are given in (18); the following sections will add to this structure.

(18) *Nganasan: interim ranking I*

Trochee　　FtBin-*μ*

*Hd$_{\text{Ft}}$/*ɨ,ə,i·u*

AlignFt-R

3.4 Conflation

This section aims to show how the Stringency Hierarchy constraints allow conflation of markedness categories. Specifically, it addresses the question of why Nganasan ignores the sonority distinction between low and mid peripheral vowels on the one hand, and high peripheral and central vowels on the other. Put in terms of constraints, this section deals with the issue of where the remaining $*\text{H}\textsc{d}_{\text{Ft}}/x$ constraints – $*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ,ə*, $*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ* and $*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ,ə,i•u,e•o* – are ranked in the grammar of Nganasan.

In a sense, the ranking proposed so far already imposes a type of implicit conflation, or 'conflation through constraint form'. The ranking above does not force foot retraction whenever there is a highly sonorous antepenult: foot retraction only occurs when it would result in a stressed syllable of significantly higher sonority. This point is illustrated in tableau (19) with the form [binýʃa]; other relevant examples include [cinýrʃa] 'smell', [kuníða] 'whence' and [ɟitúɟa] 'fire'.

(19) *Emergence of* ALIGN

binyʃa	$*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ,ə,i•u*	ALIGNFT-R
☞ a. bi(nýʃa)	*	
b. (bíny)ʃa	*	*!

Because both candidates have a stressed vowel of the same sonority, they equally violate $*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ,ə,i•u*, thereby rendering sonority irrelevant for stress placement in this competition. The equal violation of the stress-sonority constraint means that ALIGNFT-R is decisive, so favouring the candidate with the 'default' stress position: a right-aligned foot.

In effect, [u] and [y] are conflated for stress purposes – they are treated as equally (un)desirable foot heads. In constraint terms, [ú] and [ý] incur equal violations of the active sonority-stress constraint, thereby allowing a lower-ranked edge-alignment constraint to be decisive. Such 'equal violation of active constraints' is at the core of what it means to be 'conflated'.

The same is also true of [í ý ú ə́ ɨ] – these vowels are conflated for stress purposes as well, as shown by the data in (13). Therefore, it follows that these stressed vowels must incur equal violations of all active sonority-stress constraints. This situation can only be achieved in Nganasan if every constraint that distinguishes members of the set is ranked below ALIGNFT-R: i.e. $*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ* and $*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ,ə*. Tableau (20) illustrates this point with the form e.g. [hursə́ɟi] 'returns'.

(20) *Conflation of high peripheral and central vowels*

hursəɟi	$*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ,ə,i•u*	ALIGNFT-R	$*\text{H}\textsc{d}_{\text{Ft}}/$*ɨ,ə*
☞ a. hur(sə́ɟi)	*		*
b. (húrsə)ɟi	*	*!	

The reason that stress does not retract from the less sonorous [ə] onto the more sonorous [u] is that they incur the same violations of active constraints – i.e. *HD$_{Ft}$/*ɨ,ə,i·u* – and all constraints that distinguish the two stressed vowels (i.e. *HD$_{Ft}$/*ɨ,ə*) are inactive. In this way, ALIGNFT-R again emerges as decisive.

The same point can be made for *HD$_{Ft}$/*ɨ* – stress does not retract from [ɨ] to a more sonorous vowel of the 'low-sonority' set: e.g. [ɲintɨ́ðɨ] 'AUX.NEG.3DUAL', *[ɲíntɨðɨ].

There is an analogous ranking for low and mid peripheral vowels. Stress does not retract from a mid vowel penult onto a low vowel: e.g. [ba(cébsa)], *[(báceb)sa]. Therefore, all constraints that distinguish mid and low peripheral stressed vowels must be inactive: for Nganasan, *HD$_{Ft}$/*ɨ,ə,i·u,e·o* must be outranked by ALIGNFT-R. This is illustrated in tableau (21).

(21) *Conflation of low and mid peripheral vowels*

bacebsa	*HD$_{Ft}$/*ɨ,ə,i·u*	ALIGNFT-R	*HD$_{Ft}$/*ɨ,ə,i·u,e·o*
☞ a. ba(cébsa)			*
b. (báceb)sa		*!	

As in tableau (20), the competitors incur the same number of violations (i.e. none) of *HD$_{Ft}$/*ɨ,ə,i·u*, so allowing ALIGNFT-R to be decisive.

To summarise, the high vowels [í ý ú], the mid central vowel [ə́] and the high central vowel [ɨ́] are conflated for stress purposes in Nganasan because there is no active stress-sonority constraint that favours one of the sonority levels over the other. The same point holds for low [á] and mid [é ó] peripheral vowels – the constraint that distinguishes them (*HD$_{Ft}$/*ɨ,ə,i·u,e·o*) is crucially ranked below ALIGNFT-R, so rendering it inactive in the language.

To complete the ranking with respect to foot-sonority constraints, and looking ahead to §4, since Nganasan's footing system does not refer to the sonority of the foot's non-head, ALIGNFT-R must outrank almost all of the relevant *NON-HD$_{Ft}$/*x* constraints. For example, if *NON-HD$_{Ft}$/*a* outranked ALIGNFT-R, [ba(cébsa)] would be footed as *[(báceb)sa] to avoid a foot with [a] in the non-head syllable. From the same reasoning, ALIGNFT-R must outrank all *NON-HD$_{Ft}$/*x* constraints except *NON-HD$_{Ft}$/*ɨ,ə,i·u,e·o,a*. At least FTBIN-μ and TROCHEE must outrank *NON-HD$_{Ft}$/*ɨ,ə,i·u,e·o,a*, otherwise all feet would be monosyllabic.

The Nganasan ranking with the foot-sonority constraints is given in (22): the final diagram will be presented in §3.7.

(22) *Nganasan: interim ranking II*

Trochee FtBin-*μ*

*Non-Hd$_{\text{Ft}}$/*ɨ,ə,i·u,e·o,a* *Hd$_{\text{Ft}}$/*ɨ,ə,i·u*

AlignFt-R

*Hd$_{\text{Ft}}$/*ɨ* *Hd$_{\text{Ft}}$/*ɨ,ə* *Hd$_{\text{Ft}}$/*ɨ,ə,i·u,e·o*

all other *Non-Hd$_{\text{Ft}}$/*x*

3.5 The fixed ranking theory and conflation

The preceding section has shown that the Stringency Hierarchy constraints can successfully produce conflation, and specifically a system with two different sets of conflation. The aim of this section is to examine the fixed ranking theory's conflation ability. As mentioned above, it is not an easy matter to show that the fixed ranking theory cannot conflate adequately. The following subsections will show that the fixed ranking theory can produce stress systems in which there is a single conflation of contiguous sonority categories for foot heads; it does so by interleaving constraints on foot heads and unstressed syllables. However, the fixed ranking theory's foot-sonority constraints cannot produce stress systems with more than one set of conflated categories (like Nganasan's) (also see Prince 1999: 11). To demonstrate why this is the case, the following discussion will start by focusing solely on the fixed ranking theory's *Hd$_{\text{Ft}}$/*x* constraints, given in (23).

(23) *Fixed ranking stress-sonority constraints* (Kenstowicz 1997)

*Hd$_{\text{Ft}}$/ɨ ≫ *Hd$_{\text{Ft}}$/ə ≫ *Hd$_{\text{Ft}}$/i,u ≫ *Hd$_{\text{Ft}}$/e,o ≫ *Hd$_{\text{Ft}}$/a

§3.5.1 will identify the types of conflation that the constraints in (23) allow. The discussion will then consider constraints on sonority in unstressed syllables, and show how a combination of the two can produce a variety of conflations (§3.5.2). The discussion will show that even with both sets of constraints, certain types of conflation are impossible in the fixed ranking system (§3.5.3). Finally, §3.5.4 considers whether some other constraint (interacting with the fixed ranking constraints) could produce conflation.

3.5.1 *Fixed ranking constraints and conflation.* The fixed ranking theory can produce certain types of conflation, given certain assumptions about existing constraints. The fixed ranking head-sonority constraints in (23) can conflate certain sets of categories: namely those that include the least marked sonority element with respect to the *Hd/*x* constraints – i.e. [a].

For example, the constraints can conflate [é ó] with [á]. For a Nganasan-like system, as long as ALIGNFT-R outranks $*\text{HD}_{\text{Ft}}$/e,o, conflation is obtained. The crucial part of the ranking is shown in tableau (24); the full ranking is $*\text{HD}_{\text{Ft}}$/ɨ ≫ $*\text{HD}_{\text{Ft}}$/ə ≫ $*\text{HD}_{\text{Ft}}$/i,u ≫ ALIGNFT-R ≫ $*\text{HD}_{\text{Ft}}$/e,o ≫ $*\text{HD}_{\text{Ft}}$/a.

(24) *Fixed ranking: 'unmarked' conflation*

bacebsa	$*\text{HD}_{\text{Ft}}$/i,u	ALIGNFT-R	$*\text{HD}_{\text{Ft}}$/e,o
☞ a. ba(cébsa)			*
b. (báceb)sa		*!	

The constraint $*\text{HD}_{\text{Ft}}$/i,u must outrank ALIGNFT-R to ensure correct stressing on [kóruðə] and other words with the form [C{a o ɔ}C{i y u}CV]. In contrast, by having ALIGNFT-R outrank all constraints that distinguish mid peripheral from low stressed vowels (i.e. $*\text{HD}_{\text{Ft}}$/e,o and $*\text{HD}_{\text{Ft}}$/a), the two categories are conflated.

3.5.1.1 *Limitations: conflation of 'marked' categories.* Because the fixed ranking constraints are in a fixed ranking, establishing the ranking of a single $*\text{HD}_{\text{Ft}}/x$ constraint and ALIGNFT-R immediately establishes ALIGNFT-R's ranking with respect to other $*\text{HD}_{\text{Ft}}/x$ constraints. For example, since ALIGNFT-R must outrank $*\text{HD}_{\text{Ft}}$/e,o, ALIGNFT-R must also outrank $*\text{HD}_{\text{Ft}}$/a. Similarly, all $*\text{HD}_{\text{Ft}}/x$ constraints that outrank $*\text{HD}_{\text{Ft}}$/i,u (including $*\text{HD}_{\text{Ft}}$/ɨ and $*\text{HD}_{\text{Ft}}$/ə) must also outrank ALIGNFT-R. The ranking implication has a significant effect on the activity of a constraint, and therefore on conflation. Because both $*\text{HD}_{\text{Ft}}$/ə and $*\text{HD}_{\text{Ft}}$/i,u are active (i.e. they outrank ALIGNFT-R), high peripheral stressed vowels are not conflated with schwa, a point illustrated in tableau (25) with [cuhə́nu].

(25) *Fixed ranking: no conflation of 'marked' categories*

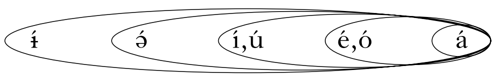
cuhənu	$*\text{HD}_{\text{Ft}}$/ə	$*\text{HD}_{\text{Ft}}$/i,u	ALIGNFT-R
☜ a. (cúhə)nu		*	*
b. cu(hə́nu)	*!		

The problem illustrated in (25) arises from the nature of conflation. Two categories are conflated when no active constraint assigns them distinct violations. So, for Nganasan, the constraints that distinguish stressed high central from mid central vowels – i.e. $*\text{HD}_{\text{Ft}}$/ə and $*\text{HD}_{\text{Ft}}$/ɨ – must be inactive. However, because $*\text{HD}_{\text{Ft}}$/i,u is necessarily active, and both $*\text{HD}_{\text{Ft}}$/ə and $*\text{HD}_{\text{Ft}}$/ɨ outrank $*\text{HD}_{\text{Ft}}$/i,u, $*\text{HD}_{\text{Ft}}$/ə and $*\text{HD}_{\text{Ft}}$/ɨ are also active, with the consequence that high vowels cannot be conflated with any other category.

To put the implication in more general terms, focusing on just the $*\text{HD}_{\text{Ft}}/x$ constraints: if a language distinguishes category α from β for stress purposes, then the language will treat all categories that are less marked than either α or β in terms of the $^*\mathrm{HD}_{\mathrm{Ft}}/x$ constraints as distinct for stress purposes. For example, for Nganasan one α–β pair is formed by mid peripheral and high peripheral vowels – these categories are treated distinctly in stress assignment. So, this implies that everything less marked than mid and high peripheral vowels – namely central vowels – should be treated as distinct from every other category as well; this is incorrect, as central vowels and high peripheral vowels are conflated in Nganasan.

3.5.1.2 *Generalisation.* To summarise the result above, the fixed ranking $^*\mathrm{HD}_{\mathrm{Ft}}/x$ constraints can effect the conflations marked in (26). Each oval contains a set of potentially conflated categories; no set of categories can be conflated if they are not enclosed within a single oval (e.g. [ə́] cannot be conflated with [í,ú] alone).

(26) *Conflations of foot head sonority categories using only* $\mathrm{HD}_{\mathrm{Ft}}/x$ *constraints*



The case presented above can be generalised for the fixed ranking theory. Essentially, for a single set of constraints, the fixed ranking theory places a restriction on possible conflations, stated in (27).

(27) *Fixed ranking and unmarked-category conflation*

Given a hierarchy $H = |\alpha \rangle \beta \rangle \ \ldots \ \rangle \gamma|$,
a head position P,
and a set of constraints in a fixed ranking $^*P/\gamma \gg \ldots \gg {}^*P/\beta \gg {}^*P/\alpha$,
holding all else equal,
if γ and β in hierarchy H are conflated,
γ and β are also conflated with all α in hierarchy H such that $\alpha \rangle \gamma$ or $\alpha \rangle \beta$.

For a non-head position Q, the set of constraints are $^*Q/\alpha \gg {}^*Q/\beta \gg \ \ldots \ \gg {}^*Q/\gamma$, and if α and β are conflated, then α and β are also conflated with all γ in H such that $\alpha \rangle \gamma$ or $\beta \rangle \gamma$.

For example, in terms of the $^*\mathrm{HD}_{\mathrm{Ft}}/x$ constraints, if a language conflates the distinction between [ə] and [e] for foot heads, the fixed ranking theory predicts that the distinction between 'ə' and all other less marked categories (i.e. 'i,u' and 'a') is also conflated. The problem encountered in Nganasan is that there is a set of conflated vowels – i.e. {í ý ú ə́ ɨ́} – that do not include less marked elements in terms of foot heads (i.e. {é ó á}).

However, the clause 'holding all else equal' is important – the effect of (27) is only transparent if there are no constraints that contradict the markedness relations imposed by the relevant hierarchy in a certain way. As we shall see in §4, the empirical prediction of (27) is fully transparent in relation to sonority and foot non-heads – i.e. conflation of 'marked' categories in foot non-heads is not possible using fixed ranking unstressed-sonority constraints. It is also fully transparent with hierarchies such as place of articulation (see de Lacy 2002a: chs. 6–8). However, for stress and sonority, the implications of (27) are obscured by the fact that there is a 'complementary' set of constraints.

3.5.2 *Complementary constraints.* For a set of constraints in a fixed ranking with the form $*P/\gamma \gg *P/\beta \gg *P/\alpha$, conflation of γ and β without conflation of α with respect to P is possible if there is a complementary set of constraints $*P'/\alpha \gg *P'/\beta \gg *P'/\gamma$, where P′ refers to a structural position that is the appropriate complement of P.

For heads and sonority, the set of constraints in (28) can produce 'marked' conflation; these constraints differ from the $*\text{HD}_{\text{Ft}}/x$ constraints in that they refer to the appropriate complementary structural position – i.e. 'unstressed syllables' ($\breve{\sigma}$) – and reverse the sonority scale.[9]

(28) *Unstressed-sonority constraints*

$*\breve{\sigma}/\text{a} \gg *\breve{\sigma}/\text{e,o} \gg *\breve{\sigma}/\text{i,u} \gg *\breve{\sigma}/\text{ə} \gg *\breve{\sigma}/\text{ɨ}$

Note that the foot-non-head position is not the complement of foot-head position for present purposes. As shown below, to be effective in conflation, the 'complementary' constraints need to refer to every syllable nucleus that is not a foot head; such positions include both foot non-heads and unfooted syllables – i.e. unstressed syllables.

The unstressed-sonority constraints can produce conflation of central and high peripheral vowels in stressed syllables (tableau (29a)) while allowing mid vowels to attract stress (tableau (29b)). All $*\text{HD}_{\text{Ft}}/x$ constraints are ranked below ALIGNFT-R.

(29) *Unstressed-sonority constraints: (a) conflation of high and mid central vowels; (b) foot retraction*

		$*\breve{\sigma}$/e,o	ALIGNFT-R	$*\breve{\sigma}$/i,u	$*\breve{\sigma}$/ə
a.	cuhənu				
	i. (cúhə)nu		*!	*	*
	☞ ii. cu(hə́nu)			**	
b.	solətu				
	☞ i. (sólə)tu		*	*	*
	ii. so(lə́tu)	*!		*	

Tableau (29a) shows that the ranking allows stressed high and mid central vowels to be conflated. There is no $*\breve{\sigma}/x$ constraint that outranks ALIGNFT-R and favours [í] over [ə́], so candidate (29a.i) fatally violates

[9] Precedent for the constraints in (28) is found in Crosswhite (1999), though they are not used to produce sonority-driven stress in that work.

ALIGNFT-R. This follows because the $*\breve{\sigma}/x$ constraints penalise unstressed high-sonority vowels; whether stress falls on [i] or [ə] will not change the number of high-sonority vowels (i.e. [e o a]) that are unstressed.

Tableau (29b) shows that the $*\breve{\sigma}/x$ constraints can impose a sonority distinction. By having stress on [ə] in (29b.ii), the mid vowel [o] is unstressed and so incurs a violation of $*\breve{\sigma}$/e,o. Candidate (29b.i) avoids this situation by placing stress on the mid vowel.

In short, the $*\breve{\sigma}/x$ constraints can produce conflation of 'marked' categories. However, it is important to point out that the generalisation in (27) is still correct: the $*\breve{\sigma}/x$ constraints can only conflate 'unmarked-end' categories. In the tableaux above, the constraints conflate the categories 'high peripheral unstressed vowels' with 'central unstressed vowels' with respect to unstressed syllables. The result is that the constraints do not allow conflation of the elements that are marked with respect to unstressed syllables – i.e. low and mid vowels. For Nganasan, the result is that the $*\breve{\sigma}/x$ constraints do not allow conflation of [á] and [é ó]:

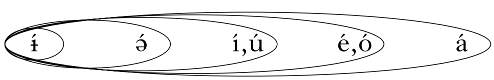
(30) *Unstressed-sonority constraints: no conflation of low and mid peripheral vowels*

kacemәʔ	$*\breve{\sigma}$/a	$*\breve{\sigma}$/e,o	ALIGNFT-R
☞ a. (káce)mәʔ		*	*
b. ka(cémәʔ)	*!		

The problem encountered in tableau (30) is similar to the problem in tableau (25): $*\breve{\sigma}$/e,o must outrank ALIGNFT-R to produce sonority sensitivity, but this means that $*\breve{\sigma}$/a also outranks ALIGNFT-R, so preventing conflation of low with mid peripheral vowels.

To summarise, the $*\breve{\sigma}/x$ constraints on their own can produce the conflations of stressed vowels given in (31).

(31) *Conflations of foot head vowels using only $*\breve{\sigma}/x$ constraints*



The final step in is to consider whether a combination of the $*\text{HD}_{\text{Ft}}/x$ and $*\breve{\sigma}/x$ constraints can produce stress systems with two conflations, as in Nganasan.

3.5.3 *Double conflation.* §§3.5.1 and 3.5.2 have shown that the $*\text{HD}_{\text{Ft}}/x$ and $*\breve{\sigma}/x$ constraints cannot adequately produce Nganasan's conflations when considered separately. This section shows that it is not possible to interleave the two constraint series to produce two sets of conflations in the same stress system.

§3.5.1 showed that the $*\text{HD}_{\text{Ft}}/x$ constraints could produce conflation of mid and low peripheral vowels for stress purposes, given the ranking

*HD$_{\mathrm{Ft}}$/ɨ ≫ *HD$_{\mathrm{Ft}}$/ə ≫ *HD$_{\mathrm{Ft}}$/i,u ≫ ALIGNFT-R ≫ *HD$_{\mathrm{Ft}}$/e,o ≫ *HD$_{\mathrm{Ft}}$/a. However, this comes at the cost of preventing conflation of central and high peripheral vowels. Since conflation is related to constraint activity, the fact that central and high peripheral stressed vowels will incur different violations of active constraints means that they cannot be conflated. In contrast, §3.5.2 showed that the *σ̆/*x* constraints could produce conflation of central and high peripheral vowels for stress purposes, but at the cost of preventing conflation of mid and low peripheral vowels, with the ranking *σ̆/a ≫ *σ̆/e,o ≫ ALIGNFT-R ≫ *σ̆/i,u ≫ σ̆/ə ≫ *σ̆/ɨ.

So, focusing on the *HD$_{\mathrm{Ft}}$/*x* and *σ̆/*x* constraints alone (see §3.5.4 for other constraints), is it possible to merge the two rankings above so that their positive effects (i.e. their conflations) are retained, while their implications for lack of conflation are eliminated? The answer is 'no'. Considering the ranking *HD$_{\mathrm{Ft}}$/ɨ ≫ *HD$_{\mathrm{Ft}}$/ə ≫ *HD$_{\mathrm{Ft}}$/i,u ≫ ALIGNFT-R ≫ …, the problem here is that *HD$_{\mathrm{Ft}}$/ɨ, *HD$_{\mathrm{Ft}}$/ə and *HD$_{\mathrm{Ft}}$/i,u are active. By being active, they prevent conflation of central and high peripheral vowels. Therefore, these constraints must be rendered inactive.

Introducing active *σ̆/*x* constraints to the ranking will not help. For example, *σ̆/a does not reduce the number of distinctions between sonority categories for stress – in fact it increases them, distinguishing between [á] and every other category. In short, the ranking *σ̆/a ≫ *HD$_{\mathrm{Ft}}$/ɨ ≫ *HD$_{\mathrm{Ft}}$/ə ≫ *HD$_{\mathrm{Ft}}$/i,u ≫ ALIGNFT-R ≫ … does not affect the fact that *HD$_{\mathrm{Ft}}$/ɨ, *HD$_{\mathrm{Ft}}$/ə and *HD$_{\mathrm{Ft}}$/i,u are active, and therefore prevent conflation.

With the constraints under consideration, the only way to render *HD$_{\mathrm{Ft}}$/ɨ, *HD$_{\mathrm{Ft}}$/ə and *HD$_{\mathrm{Ft}}$/i,u inactive is to rank them below ALIGNFT-R: the ranking ALIGNFT-R ≫ *HD$_{\mathrm{Ft}}$/ɨ ≫ *HD$_{\mathrm{Ft}}$/ə ≫ *HD$_{\mathrm{Ft}}$/i,u … ensures that central and high peripheral vowels will be treated equally for stress purposes. However, the ranking means that the *HD$_{\mathrm{Ft}}$/*x* constraints play no role in stress placement: since all *HD$_{\mathrm{Ft}}$/*x* constraints are inactive, they cannot motivate sonority-driven retraction in forms like [(sólə)tu].

If the *HD$_{\mathrm{Ft}}$/*x* constraints have no effect on stress placement, then the sonority sensitivity in Nganasan stress must be due entirely to the *σ̆/*x* constraints. However, if *σ̆/a and *σ̆/e,o are active, conflation between mid and low peripheral vowels is prevented. Consequently, *σ̆/a and *σ̆/e,o must be ranked below ALIGNFT-R as well. The problem then arises that the ranking ALIGNFT-R ≫ *σ̆/a ≫ *σ̆/e,o ≫ … prevents the *σ̆/*x* constraints from playing any role in stress assignment. If neither any *HD$_{\mathrm{Ft}}$/*x* or *σ̆/*x* constraint is active, there is no way for stress to be sensitive to sonority: ALIGNFT-R will have to be decisive, incorrectly favouring *[so(lə́tu)] over [(sólə)tu].

To summarise, for two sonority categories to be conflated for stress purposes, all constraints that distinguish them must be inactive. For Nganasan's conflation of central and high peripheral vowels, this means that *HD$_{\mathrm{Ft}}$/ɨ, *HD$_{\mathrm{Ft}}$/ə, *HD$_{\mathrm{Ft}}$/i,u, *σ̆/i,u, *σ̆/ə and *σ̆/ɨ must be inactive. For Nganasan's conflation of mid and low peripheral vowels, *HD$_{\mathrm{Ft}}$/e,o,

*Hd$_{Ft}$/a and $^*\breve{\sigma}$/a $^*\breve{\sigma}$/e,o must be inactive. However, if all *Hd$_{Ft}/x$ and $^*\breve{\sigma}/x$ constraints are inactive, there is no way to distinguish any sonority categories for stress, thereby necessitating that stress is not sensitive to sonority in Nganasan, contrary to fact.

3.5.4 *Other constraints.* The discussion above has focused on *Hd$_{Ft}/x$ and $^*\breve{\sigma}/x$ constraints in a fixed ranking, showing that the two constraint sets cannot produce 'double conflation'. But what about other constraints in Con: is it possible that some other constraint(s) could interact with the fixed ranking constraints to allow double conflation in Nganasan?

Given standard assumptions about mechanisms available in OT (i.e. ranking), it is possible to determine the violation profile of such (a) constraint(s). It was shown above that if *Hd$_{Ft}/x$ or $^*\breve{\sigma}/x$ constraints are active, they prevent conflation. Focusing on the *Hd$_{Ft}/x$ constraints, if *Hd$_{Ft}$/i,u outranks AlignFt-R, then [ɨ́], [ə́] and [í ú] are predicted not to be conflated, due to the necessary activity of the constraints *Hd$_{Ft}$/ɨ and *Hd$_{Ft}$/ə. In order to prevent *Hd$_{Ft}$/ɨ, *Hd$_{Ft}$/ə and *Hd$_{Ft}$/i,u from making incorrect distinctions between categories for stress, some constraint(s) C would have to outrank them.

In practical terms, for Nganasan C must assign a violation to candidates that have [ɨ́], [ə́], [í], [ý] or [ú] in antepenultimate position. Furthermore, C crucially cannot assign violations to [ɨ́], [ə́], [í], [ý] and [ú] in penultimate position as well, otherwise C would have no effect on the competitions under discussion.

If C outranked *Hd$_{Ft}$/ɨ, the right result would be achieved. A series of constraints like *Antepen/$\acute{x}$: 'Assign a violation for every x in a foot head in antepenultimate position' approximates C. A ranking *Antepen/ɨ $\gg$ *Antepen/ə $\gg$ *Antepen/i,u $\gg$ *Hd$_{Ft}$/ɨ $\gg$ ... would correctly favour [cuhə́nu] over *[cúhənu] – the latter violates *Antepen/i,u, while the former only violates the lower-ranked *Hd$_{Ft}$/ə.

Of course, the *Antepen/x constraints are a local solution to the double-conflation problem: they will account for conflation in Nganasan, but not necessarily in other languages, or for other phenomena. In addition, there is some reason to doubt the existence of the *Antepen/x constraints. Along with a constituent (i.e. foot head), they encode a position in their structural description (i.e. 'third syllable from end') – such reference in constraints and rules has often been avoided, and has been shown to be unnecessary in metrical theory (e.g. Hayes 1995). The constraints also make unattested typological predictions: they predict a language in which stressed syllables become more sonorous, but only in antepenultimate position (i.e. if *Antepen/x $\gg$ Ident[F] $\gg$ *Hd$_{Ft}/x$). Such position-sensitive (as compared to constituent-sensitive) feature change has not been reported, to my knowledge.

To summarise, *Hd$_{Ft}/x$ and $^*\breve{\sigma}/x$ constraints in a fixed ranking cannot produce sonority-sensitive stress systems which refer to two or more separate sets of conflated elements on the sonority hierarchy. To produce such a conflation system, other constraints with a specific violation profile would need to be invoked, and as argued above, it is unlikely that such constraints exist.

3.6 Other alternatives

The following subsections discuss potential approaches to conflation that maintain fixed ranking and have been proposed before, or are straightforward adaptations of previous proposals. §3.6.1 examines a fixed ranking approach with stringent constraints, and shows that the same problems as with a standard fixed ranking approach are again encountered. §3.6.2 discusses an approach that employs a series of binary scales in a fixed ranking, effectively decomposing the sonority hierarchy. §3.6.3 discusses a 'representational' solution – one that employs reference to moras rather than sonority.

3.6.1 *Stringent fixed ranking.* The preceding discussion has argued that the Stringency Hierarchy constraints allow conflation of unmarked categories, while the fixed ranking constraints do not. However, it could be the case that fixed ranking is not at fault here, but rather that it is the fact that the Stringency Hierarchy constraints refer to *ranges* of a hierarchy that allows conflations. This option is easily tested by examining a combination of the two theories: one which has constraints that refer to ranges of a hierarchy and are in a fixed ranking.

For example, the same problems arise with the following set of constraints in a universally fixed ranking *HD$_{\mathrm{Ft}}$/*ɨ* ≫ *HD$_{\mathrm{Ft}}$/*ɨ·ə* ≫ *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* ≫ *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u,e·o*. *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* must outrank ALIGNFT-R in Nganasan to force retraction in [(sólə)tu]. Therefore, *HD$_{\mathrm{Ft}}$/*ɨ·ə* and *HD$_{\mathrm{Ft}}$/*ɨ* must both outrank ALIGNFT-R as well, incorrectly favouring antepenult stress in [cuhə́nu].

Other permutations of the theory meet similar problems. Suppose that the ranking between the constraints was fixed in the opposite fashion: i.e. *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u,e·o* ≫ *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* ≫ *HD$_{\mathrm{Ft}}$/*ɨ·ə* ≫ *HD$_{\mathrm{Ft}}$/*ɨ*. Again, conflation is a problem, but this time at the opposite end of the hierarchy. *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* must outrank ALIGNFT-R to force foot retraction in words like [(sólə)tu]. However, this ranking again means that *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u,e·o* must be active, thus preventing conflation of mid and low peripheral vowels.

Introducing an unstressed-syllable fixed ranking series also does not help (i.e. **σ̆/a* ≫ **σ̆/a,e·o* ≫ **σ̆/a,e·o,i·u* ≫ **σ̆/a,e·o,i·u,ə* ≫ **σ̆/a,e·o,i·u,ə,ɨ*). To produce [(sólə)tu], **σ̆/a,e·o* must outrank ALIGNFT-R; but such a ranking ensures that **σ̆/a* is active, and therefore prevents conflation of low and mid peripheral vowels.

The only way to get a fixed ranking theory of this type to work for Nganasan is to propose that the constraints universally have the ranking *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* ≫ *HD$_{\mathrm{Ft}}$/*ɨ·ə*, *HD$_{\mathrm{Ft}}$/*ɨ*, *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u,e·o*. The problem with this approach (apart from being blatantly ad hoc) is that it imposes other restrictions on conflation. Specifically, it predicts that no language may distinguish [ə] from other vowels for stress purposes without also distinguishing mid and/or low vowels from high peripheral vowels in a similar way; this follows from the fact that if $^*\text{HD}_{\text{Ft}}/ɨ\text{•}ə$ is active, then so is $^*\text{HD}_{\text{Ft}}/ɨ,ə,i\text{•}u$. A number of languages show that this prediction is incorrect – their stress systems avoid [ə́] but do not make a distinction between low, mid, and high peripheral vowels for stress purposes (e.g. Yil (Martens & Tuominen 1977) and Lillooet (van Eijk 1997); see §5).

In summary, free ranking is essential in allowing conflation. And, as shown above, the only way to effect hierarchical relations with freely rankable constraints is if the constraints refer to ranges of a hierarchy – i.e. the Stringency Hierarchy constraints.

3.6.2 *Binary features.* The typology of conflation discussed above allows examination of an alternative to the Stringency Hierarchy approach. The alternative relies on decomposing every hierarchy into a series of two-member hierarchies, or binary features. If every hierarchy consisted of just two elements, conflation could be implemented through fixed ranking.

Of present relevance is the idea that the sonority hierarchy can be decomposed into several subhierarchies, each consisting of just two members. Such an approach has a precedent in Clements' (1990: 292) account of consonant sonority; Clements proposes that the consonant-sonority hierarchy obstruent ⟩ nasal ⟩ liquid ⟩ glide can be decomposed into four features, as shown in (32). This approach contrasts with this paper's assumption that there is a single unitary sonority hierarchy with several different values.

(32) *Consonant-sonority decomposition* (Clements 1990)

obstruents ⟨	nasals ⟨	liquids ⟨	glides	
–	–	–	–	'syllabic'
–	–	–	+	vocoid
–	–	+	+	approximant
–	+	+	+	sonorant
0	1	2	3	*rank* (*relative sonority*)

Such a 'binary' approach could in principle be extended to vowel sonority. (33) illustrates a binary feature approach to vowel sonority. This features are labelled 'F', 'G', 'H', 'I' here; discussion of whether they can be identified with commonly accepted features is given below.

(33)

ɨ ⟩	*ə* ⟩	*i•u* ⟩	*e•o* ⟩	*a*	
–	–	–	–	+	F
–	–	–	+	+	G
–	–	+	+	+	H
–	+	+	+	+	I

In constraint terms, the relation of the features above to heads could be implemented by means of four hierarchies: (a) $^*\text{HD}_{\text{Ft}}/\text{–I} \gg {}^*\text{HD}_{\text{Ft}}/\text{+I}$,

(b) *HD$_{Ft}$/–H ≫ *HD$_{Ft}$/+H, (c) *HD$_{Ft}$/–G ≫ *HD$_{Ft}$/+G and (d) *HD$_{Ft}$/–F ≫ *HD$_{Ft}$/+F. Conflation is a straightforward matter. For example, to conflate central and high peripheral vowels (as in Nganasan), *HD$_{Ft}$/–I would be inactive. Importantly, *HD$_{Ft}$/–I does not imply the inactivity of *HD$_{Ft}$/–H; if *HD$_{Ft}$/–H is active, then a distinction between high and mid peripheral vowels can be maintained. In this way, the binary feature approach seems to achieve the same ends as the Stringency Hierarchy theory; however, the theories make different predictions in other areas.

3.6.2.1 *Natural Classes and binary features.* The binary feature theory makes several falsifiable predictions in relation to natural classes. It relies on the existence of the features [F], [G], [H] and [I], and these features should therefore have effects on other processes. For example, the features can be expected to participate in dissimilation, assimilation, harmony, coalescence and other relevant phonological processes. Certainly, some of the features fit with current feature theories. For example, [F] can be identified with [low], and is therefore a reasonable feature because it participates in assimilation and dissimilation (e.g. Kera; Suzuki 1998), and in vowel harmony (van der Hulst & van der Weijer 1995: 519ff).

However, feature [G] poses a problem. If [G] exists, it should participate in vowel harmony where every vowel must be either one of [ə i u] or one of [e o ɛ ɔ a]. Likewise, feature [H] predicts vowel harmony where every vowel is either central or peripheral. Such vowel harmonies are not reported in surveys such as that of Baković (2000). In short, the binary feature approach to vowel sonority inevitably relies on spurious features.

3.6.2.2 *Natural classes and multivalued features.* Of course, the result above raises the question of whether the multivalued feature approach makes similar incorrect predictions. The [sonority] feature seems to treat central and high peripheral vowels as a class, so does it also make incorrect predictions regarding harmony?

There is a principled way for the multivalued feature approach to avoid the problems just described. There are two different senses of ‘natural class’ for multivalued features. One sense of natural class relates to feature value identity: α and β are part of the same class if they have identical feature values. From the feature value identity sense of natural class, [i] and [u] form a natural class because both have the feature value *xxoo* for [sonority].

The other sense of natural class is the ‘string inclusion’ sense: α and β are part of the same class if the *x's* (or *o*'s) in α and β's feature-value strings form a substring of a certain specified *x* string. In this sense, [ə] and [i] are part of the same natural class because both segments have feature values that contain a substring of *xx*.

It is possible that different types of constraints refer to these different types of natural class. The processes identified above – assimilation, dissimilation and harmony – and their related constraints (e.g. AGREE, the OCP) can all be seen as requiring feature-value agreement. Since [ə] and [i u] do not form a natural class in terms of feature-value agreement, such harmony will not take place.

In contrast, constraints that ban certain features outright (e.g. $*\text{HD}_{\text{Ft}}/x$) could be allowed to refer to 'string inclusion'. This would allow such constraints to refer to the 'feature-value inclusion' type of natural class.

3.6.3 *Moras.* The final alternative theory considered here is a 'representational' theory in which stress cannot refer to sonority, but only to structural distinctions. In a popular version of such a theory, the stress distinction between [ɨ ə i u] and [e o a] in Nganasan would reduce to the claim that the sets of vowels have different moraic content. For example, if [ɨ ə i u] each had one mora, and [e o a] two, preference for stressed syllables with greater moraic content would produce the observed stress system with direct reference to sonority. In short, such an approach treats conflation as a side-effect of mora assignment – stress is attracted to mid and low vowels because stress is attracted to bimoraic syllables.

However, such a proposal makes several undesirable predictions. It recasts the mora as a diacritic for sonority value and interferes with its role as a marker of contrastive duration. More concretely, it has the rather surprising implication that Nganasan has a three-length vowel system: as Nganasan has contrastive vowel length, [ɨ ə i y u] would have to have one mora, [e o a] two and [ɨː əː iː yː uː eː oː aː] three. Assigning moras in this way makes incorrect predictions for footing in Nganasan. If [e o a] have two moras, it should be the case that they can form a single foot on their own. However, this is incorrect: /aba/ 'older female relative' is [(ába)], not *[(à)(bá)]. To get the right result, it would be necessary to redefine feet so that ($\sigma_{\mu\mu}$) feet were unacceptable. The end result would be that the foot system would be surprisingly non-standard, and that moras would be simply a diacritic for sonority levels, with no obvious explanatory gain. This point is even clearer in systems with several sonority distinctions for stress. For example, Gujarati makes three distinctions of short vowels ([ə] *vs.* [i u e o] *vs.* [a]); under the moraic approach, each would have different numbers of moras (Cardona 1965, de Lacy 2002a: ch. 3). Even more extremely, Kobon has a four-way distinction (Davies 1981).

As moras represent duration, it is to be expected that different moraic quantities should be implemented as significantly different vowel lengths. Measurements of vowel duration were taken from Nganasan data provided by Lublinskaya *et al.* (2000). As expected under moraic theory, long vowel duration is significantly longer than short vowel duration: the mean duration of Nganasan long vowels was 207 ms (s.d. = 22 ms; sample of 12 in CVːCV context), while the mean duration of the short vowels was 118 ms (s.d. = 16 ms; sample of 26 in CVCV context). Such a difference squares with the uncontroversial expectation that Nganasan long and short vowels differ in moraic content.

Now, if mid and low vowels in Nganasan have a different number of moras than high and central vowels, there should be both a significant and substantial difference in duration between the two groups of vowels. Of course, it is to be expected that there be some difference between the two groups, due to the intrinsically longer duration of low and mid vowels (which results from their articulatory implementation). However, there is no such significant and substantial difference. Five tokens of each vowel in the first syllable of CVCV words were measured from data in Lublinskaya *et al.* (2000).[10] The mean duration of [a e o] in this context was 123 ms (s.d. = 15 ms), while the mean duration of [i u y ə ɨ] was 115 ms (s.d. = 17 ms). The mean duration of [a e o] was not significantly longer than that of [i u y ə ɨ] in this context (using an unpaired t-test, $t = 1{\cdot}27$, $d.f. = 24$, $p = 0{\cdot}218$). Similarly, five tokens of each vowel in the final syllable of CVCV words were measured, and again the duration difference between the two groups was not significant ($t = 0{\cdot}597$, $d.f. = 23$, $p = 0{\cdot}56$; [a e o]: mean = 77 ms, s.d. = 10 ms; [i y u ə ɨ]: mean = 74 ms, s.d. = 15·7). In short, there was no significant difference between the duration of low and mid peripheral vowels compared to the others, indicating that there is no moraic difference.

In conclusion, the moraic approach to sonority-driven stress converts moras into little more than a language-specific diacritic device that is effectively synonymous with sonority, and divorces the mora from its expected role as marking duration and serving as a significant unit for determining foot well-formedness.

Representational theories also make strong predictions about other processes in the grammar. Proposing that low vowels have more moras than other vowels predicts that they can – and perhaps must – be treated differently for other mora-referring processes. For example, Nganasan has a minimal word effect: content words must contain either a single long vowel or two short vowels (e.g. [maː] 'what', [aba] 'older female relative', [əʔə] 'older brother, uncle'). If all short vowels are monomoraic and long vowels are bimoraic, the minimal word restriction is easy to state: words must contain a minimum of two moras (i.e. an acceptable foot). If [i y u ə ɨ] have one mora, [a e o] two and long vowels three, however, this simple statement is much more complex: e.g. *[ta] is not a possible content word, but [əʔə] is, yet both contain two moras. This prediction is extensively discussed and criticised by Gordon (1999), so I will refrain from discussing it in detail here.

Another popular representational theory relates specifically to the opposition between schwa and peripheral vowels, and relies on the idea that schwa lacks phonological features (e.g. van Oostendorp 1995 and references cited therein). With additional theoretical devices, this fact makes schwas 'weak', and consequently unable to bear to stress. This theory is one of a class that considers schwa to be fundamentally phonologically different from all other vowels. In contrast, the approach to stress

[10] There are obvious limitations to these measurements: five tokens per vowel are clearly too few. The limitations were due to the source of the data: i.e. Lublinskaya *et al.* (2000) is a fixed corpus of words. In addition, the exact shape of the CVCV words for each token was variable – there were five different words for each vowel. In the majority of cases, though, the context was [$stop_1 + V_1 + stop_2 + V_2$], with V_1 and V_2 often agreed on rounding and in near half of the cases being identical. The words were read, spoken in isolation and all came form the same speaker.

proposed here denies that schwa is significantly different from other vowels in phonological terms – the only difference is that schwa is lower on the sonority hierarchy than (most) other vowels. The fact that Nganasan treats high peripheral vowels, schwa and [ɨ] in the same way for stress supports the present proposal: it cannot be the case that lack of features repels stress, these vowels would all be phonologically featureless, and therefore phonologically indistinct. So stress does not show that schwa is fundamentally different from other vowels, phonologically speaking. Schwa is simply low on the sonority hierarchy; its behaviour in phonological processes follows from this fact, not from its lack of features.

In summary, attempts to approach the conflation problem by appealing to representational differences among vowels leads to unsupported predictions regarding duration, mora-sensitive phonological processes or difficulties in accounting for vowel contrasts.[11]

3.7 Remaining issues

This section addresses remaining issues relating to Nganasan's stress patterns. §3.7.1 shows why sonority sensitivity in Nganasan is limited to a 'stress window', and discusses variation in stress. §3.7.2 addresses the issue of optionality in Nganasan stress.

3.7.1 *The stress window.* While main stress appears on the antepenult under the right sonority conditions in Nganasan, it never appears on preceding syllables. For example, main stress never retracts to the pre-antepenult: e.g. [nàgətə́nə] 'stands up (ELATIVE)', *[nágətənə]. Eugene Helimski (personal communication) reports a more complex effect: stress retraction to the antepenult is the norm in three-syllable words (e.g. [nákyryʔ] 'three'), but is uncommon in four-syllable words: e.g. [ŋàmʲacýmə] ~ ˀ[ŋamʲácymə] 'nine'. Footing constraints account for this limit on stress retraction. Two constraints are relevant in preventing pre-antepenult stress.

(34) a. PARSE-σ
Every syllable is associated to a foot (Prince & Smolensky 1993).

b. HDFT-R
The rightmost foot is the head (Tesar 1997).

The constraint PARSE-σ requires exhaustive footing. It is outranked by FTBIN-μ in Nganasan, as degenerate feet are banned. In contrast, PARSE-σ outranks ALIGNFT-R, as shown by the presence of secondary stress in longer words: [kìntələ̀btɨkútiŋ] 'you are smoking'.

[11] I have not discussed approaches which appeal to fine-grained phonetic properties to locate stress (e.g. Gordon 1999, 2002) as – representationally speaking – there is nothing obviously incompatible with a stringency approach and such theories.

(35)

kintələbtɨkutiŋ	Parse-σ	AlignFt-R
☞ a. (kìntə)(lə̀btɨ̀)(kútiŋ)		**** **
b. kintələbtɨ(kútiŋ)	****!	

The constraint HdFt-R requires the rightmost foot to be the head. Together, Parse-σ and HdFt-R ensure that main stress does not retract to the pre-antepenult. This point is illustrated with the word /nagətənə/ in tableau (36).

(36)

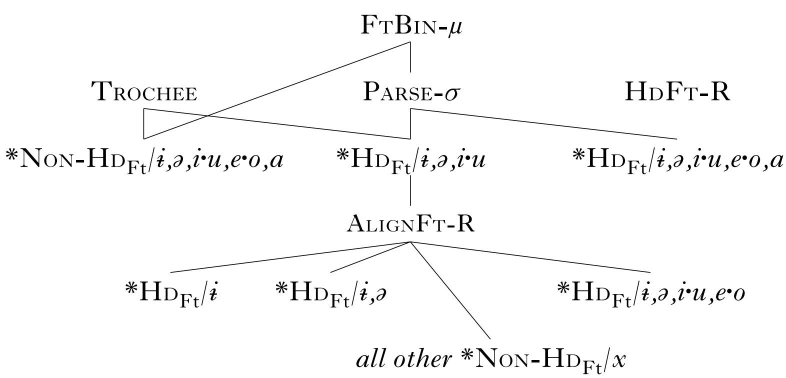
nagətənə	HdFt-R	Parse-σ	*Hd$_{\text{Ft}}$/*ɨ,ə,i•u*	AlignFt-R
☞ a. (nàgə)(tə́nə)			*	**
b. (nágə)tənə		**!		**
c. (nágə)(tə̀nə)	*!		*	**

Note that no ranking involving HdFt-R is established in (36), as all other constraints are equally violated by candidates (a) and (c).

The ranking shows the difficulties that arise with pre-antepenult stress. If main stress falls on the pre-antepenult as in (b) and (c), either Parse-σ or HdFt-R is violated. In (b), Parse-σ is violated because there are unfooted syllables; in (c), HdFt-R is violated because the head foot is not the rightmost one. With these constraints outranking *Hd$_{\text{Ft}}$/*ɨ,ə,i•u*, it is more harmonic to stress a low-sonority vowel, as in (a).

As a concluding note, the remaining *Hd$_{\text{Ft}}$/*x* constraint *Hd$_{\text{Ft}}$/*ɨ,ə,i•u,e•o,a* must be ranked below Parse-σ, otherwise it would force only one foot per word. The resulting ranking is summarised in (37).

(37) *Nganasan: final ranking*



3.7.2 *Variation.* Given the ranking in (37), the issue of free variation in the stress system can be broached. Helimski (1998: 486, personal communication) reports stress retraction due to sonority to be optional.

Unfortunately, this discussion must remain somewhat tentative, as details on the extent of such optionality are limited.

Nevertheless, both Helimski's and Tereshchenko's (1979: 41) data shows the optionality active in trisyllabic words: e.g. [hékutɨ] and [sólətu] show sonority-driven retraction, while [cerə́ʔsi] does not. It seems that the majority of trisyllabic forms with the right shape show sonority retraction, as reported by Helimski (personal communication) and attested in Tereshchenko's data.

Essentially, the optionality boils down to whether stress is sensitive or insensitive to sonority. The ranking responsible for sonority sensitivity involves *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* and ALIGNFT-R. If ALIGNFT-R outranked *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u*, feet would be aligned as far right as possible, regardless of sonority.

There are a number of ways to implement optionality in Optimality Theory (see references cited in McCarthy 2002: §4.6). Anttila (1997) proposes local variable ranking, by which two (or more) constraints are unranked with respect to each other, but they are ordered each time the grammar is employed (see Anttila & Cho 1998 for details). Therefore, *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* and ALIGNFT-R are unranked in the grammars of Nganasan speakers with free variation. Grammar instantiations in which there is stress retraction are those in which *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* outranks ALIGNFT-R. In contrast, when ALIGNFT-R outranks *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* there is no sonority sensitivity, so main stress falls on the penult.

A final interesting issue in optionality is the behaviour of four-syllable words. While sonority can influence stress in words with three light syllables, its effect, as noted above, is less pervasive in four-syllable words: e.g. [ŋàmʲacýmə] ~ ʔ[ŋamʲácymə]. The question then arises as to why sonority sensitivity should be blocked in four-syllable words, but occur in three-syllable ones.

Interestingly, the ranking established above already accounts for the four-syllable word facts. If stress did appear on the antepenult in four-syllable words, the output form would have two unfooted syllables: *[ŋa(mʲácy)mə]. In comparison, the penult-stressed form has no unfooted syllables: [(ŋàmʲa)(cýmə)]. The avoidance of the former shows the activity of PARSE-σ, as illustrated in tableau (38).

(38)

ŋamʲacymə	PARSE-σ	*HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u*
☞ a. (ŋàmʲa)(cýmə)		*
b. ŋa(mʲácy)mə	*!*	

Importantly, the ranking does not affect trisyllabic words. In trisyllabic forms, either antepenult or penult stress will incur the same violations of PARSE-σ, allowing the influence of *HD$_{\mathrm{Ft}}$/*ɨ,ə,i·u* to emerge. This situation is illustrated in tableau (39). Of course, FTBIN-μ must outrank PARSE-σ to ensure avoidance of degenerate feet.

(39)

batyʔo	FtBin-μ	Parse-σ	*Hd$_{Ft}$/*ɨ,ə,i·u*
☞ a. (báty)ʔo		*	
b. ba(týʔo)		*	*!
c. (báty)(ʔó)	*!		

The analysis predicts that larger odd-syllable stress domains should also undergo stress retraction, while larger even-syllable domains should not, as in (35). Unfortunately, appropriate examples have not been reported in the literature, and are hard to come by in any case.

In short, optionality in Nganasan stress can be accounted for by using partial orderings of constraints. Moreover, the lack of stress optionality in four-syllable words provides support for the ranking proposed here as it straightforwardly follows from rankings needed for other purposes.

3.8 Summary

This section has argued that the Stringency Hierarchy theory can account for cases where the distinction between two categories is ignored – i.e. markedness conflation. The core argument was that the Stringency Hierarchy constraints allow 'multiple' conflation – where two or more sets of categories are conflated. Conflation of two categories comes about when all active markedness constraints that assign different violations to the two categories are inactive. So, because *Hd$_{Ft}$/*ɨ,ə,i·u,e·o* is inactive in Nganasan, the language's stress system ignores the distinction between low and mid peripheral vowels; an analogous point holds for *Hd$_{Ft}$/*ɨ·ə* and *Hd$_{Ft}$/*ɨ*. In contrast, the fixed ranking theory can only produce sonority-driven stress systems with a single set of conflated categories. The net result is that the Stringency Hierarchy theory is less empirically restrictive than the fixed ranking theory, but more empirically adequate.

4 Foot non-heads and conflation in Kiriwina

The aim of this section is to show that the Stringency Hierarchy constraints provide an account of conflation of sonority categories in foot non-heads – i.e. footed unstressed syllables. Such conflation is found in Kiriwina. The stress system of Kiriwina is remarkable in that it relies on the sonority of the non-head syllable of the foot; in contrast to Nganasan, the sonority of the stressed syllable is irrelevant.

Conflation in foot non-heads is shown to be another situation which distinguishes between the fixed ranking and stringency theories: i.e. the fixed ranking theory's stress-sonority constraints are unable to produce conflation of unmarked categories in foot non-heads. In contrast to the *Hd/*x* constraints, it is not possible to appeal to a set of constraints that is the exact complement of the *Non-Hd/*x* constraints; specifically, there are no *ξ/*x* constraints, where ξ refers to both heads and unfooted syllables, and the constraints reverse the markedness of the sonority scale relative to the *NON-HD/*x* constraints (i.e. $*\xi/a \gg *\xi/e,o \gg *\xi/i,u \gg *\xi/ə \gg *\xi/ɨ$). Reasons why the $*\xi/x$ constraints cannot exist are given in §4.5.

§4.1 describes Kiriwina's stress system and §§4.2–4.4 provide an analysis. §4.5 discusses Kiriwina's relevance for fixed ranking theories with 'structurally complementary' constraints and §4.6 presents a summary.

4.1 Kiriwina

Kiriwina – also called Kilivila – is spoken in the Trobriand Islands and the Milne Bay province of Papua New Guinea. The description and data presented here come from Lawton's (1993) and Senft's (1986) grammars.

Kiriwina has five vowels, [i e a o u], and a (C)V(V)(m) syllable structure.[12] Bivocalic nuclei can contain the diphthongs [ai au ei eu oi ou], but long vowels are not allowed (Senft 1986: 12, 20). Mid vowels almost never occur word-finally (Senft 1986: 24).[13]

Kiriwina's stress system is much like Nganasan's: stress usually falls on a final bimoraic syllable (i.e. CVV(C), CVC), otherwise on the penult.

(40) *Default stress in Kiriwina*

a. *Stress a final heavy syllable* (CVV(C), CVC)

[i.va.bo.da.ním]	'he came last walking'
[ba.kám]	'I will eat'
[i.ki.úm]	'he did secretly'
[tau.áu]	'hey, men!'
[la.ka.tu.pói]	'I have asked'

b. *Otherwise stress the penult*

[i.dó.ja]	'it drifts'
[dum.da.bó.gi]	'early dawn'
[péu.la]	'strong'
[i.mom.kó.li]	'he tasted (it)'
[am.bái.sa]	'where?'
[náu.ʔu]	'nose plug'

However, stress falls on the antepenultimate syllable in one situation: when the penult contains a high vowel and the ultima contains [a] (Lawton 1993: 45, Senft 1986: 25).

[12] Coda [m] can only appear with monomoraic nuclei and the diphthongs [ai ei] (Senft 1986: 21); no examples of CVVm syllables were provided with stress indicated in the sources. [m] can also appear as the sole nucleus in a word-initial syllable: e.g. [m.to.na] 'he (3SG)', [m.sa] 'afterbirth', [m.dau.va.li] 'fly'. In these cases, stress can fall on [m]: e.g. [ḿə.wo] (island name), [ḿ.na] (PARTICLE) (Lawton 1993: 23).

[13] Senft (1986: 24) states that mid vowels 'are rarely found in word-final position, except when used in poetic and emphatic forms'. I found no tokens in his data with both final mid vowels and stress marked. The present analysis predicts that words of the form [CVC{i u}C{e o}] would have antepenult stress.

(41) [CV́C{i u}Ca] *in Kiriwina*

a. [CV́CiCa]

[mí.gi.la]	'the face'
[tom.méi.ki.ta]	'selfish person'
[lá.mi.la]	'outrigger log'
[vi.gim.-kó.vi.la]	'to complete'
[lu.ko.-sí.si.ga]	(clan name)
[kú.li.a]	'cooking pot'
[ka.tu.-sa.wá.si.la]	'clear throat'
[la.ó.di.la]	'jungle'

b. [CcuCa] (TYPO. Should be: [C'VCuCa])

[la.sí.ku.la]	'pull canoe'
[mé.gu.va]	'white magic'
[pá.ku.la]	'blame'
[lú.gu.ta]	'yam type'
[m.lo.mʷá.lu.va]	'a red soil'
[bú.lu.va]	'thong tying door'

In contrast, stress does not retract when the penult contains a non-high vowel (42a), or when the ultima contains a high vowel (42b).

(42) *Kiriwina non-retraction*

a. [CVC{é ó á}Ca]

[tom.to.mó.ta]	'dumb'
[i.dó.ja]	'it drifts'
[ka.wá.la]	'canoe pole'
[bo.ná.ra]	'shelf (in house)'

b. [CVCV́C{i u}]

[i.gi.bu.lú.i]	'he is angry at'
[m.tu.mʷá.tu]	'shaggy'
[m.do.wá.li]	'housefly'
[i.vá.gi]	'he did (it)'
[gu.gu.lom.bʷai.lí.gu]	'the meeting I love'
[m.si.mʷé.si]	(grass type)
[i.mom.kó.li]	'he tasted (it)'
[dum.da.bó.gi]	'early dawn'
[m.ló.pu]	'cave'
[i.koi.sú.vi]	'he puts in'

No forms of the shape [CVCVC{e o}] are cited, because word-final mid vowels are very rare word-finally, and none with the right structure were cited in the sources.

Increased loudness and duration are the primary correlates of stress (Lawton 1993: 43). Evidence for stress placement is also found in stress-conditioned allophony (Lawton 1993: 18). In addition, Lawton (1993: 99) also observes that focus is marked by replacing the final vowel of verbs with a high vowel: e.g. [lumkola] 'feel', [lumkoli] 'feel (WITH FOCUS)'. In words with otherwise antepenultimate stress, Lawton reports that the vowel change causes stress to appear on the penult, though he does not give transcriptions of relevant examples.

Kiriwina's stress system can be explained by referring to the sonority of the non-head of feet. The stress system clearly employs a right-aligned quantity-sensitive trochaic foot (e.g. [ba(kám)], [dumda(bógi)]). However, an overriding condition is that feet must avoid highly sonorous vowels – specifically [a e o] – in non-head syllables. For example, /migila/ cannot be footed as *[mi(gíla)], as this would result in a high-sonority [a] in the non-head position. In contrast, with the foot retracted from the right edge the non-head syllable contains a low-sonority vowel: i.e. [(mígi)la].

As expected, foot retraction does not take place when it would result in a high-sonority mid or low vowel in the non-head anyway: e.g. [bo (nára)], *[(bóna)ra]; [i(dója)], *[(ído)ja]; [dumda(bógi)], *[dum(dábo)gi]; [mtu(m^{w}átu)], *[m(túm^{w}a)tu].

4.2 Foot non-heads

The analysis of the default stress pattern in Kiriwina is the same as for Nganasan: i.e. Kiriwina employs a quantity-sensitive trochaic foot, aligned as close to the right PrWd boundary as possible: e.g. [ba(kám)], [tau(áu)], [i(dója)], [imom(kóli)], [am(bái)sa]. Forms like [ba(kám)] show that the system is quantity-sensitive (*[(bákam)], so feet have the form CVX (e.g. [ba(kám)], [tau(áu)]) or CVCV (e.g. [i(dója)]). There is no evidence that feet are ever iambic or degenerate. Therefore, the constraints TROCHEE and FTBIN-μ are undominated in this language.

As in Nganasan, right-edge foot alignment is promoted by the constraint ALIGNFT-R. Violations of ALIGNFT-R can conceivably be forced by FTBIN-μ, as in [(náu)ʔu]: for this candidate to have a right-aligned foot, the foot would either be degenerate (e.g. *[nau(ʔú)]) or trimoraic (e.g. *[(náuʔu)]). In short, the ranking for Kiriwina default stress is FTBIN-μ, TROCHEE $\gg$ ALIGNFT-R. Another relevant candidate is *[na(úʔu)], in which right foot alignment is achieved at the expense of splitting the syllable [nau] in two. In constraint terms, ONSET must therefore outrank ALIGHFT-R (see Prince & Smolensky 1993: §3.2 for a case with the opposite ranking). In a similar vein, *NON-HD$_{Ft}$/*a,e•o,i•u* mut also outrank ALIGNFT-R to favour [tom(méi)kita] over [tomme(íki)ta] (see tableau (44)).

Constraints on foot non-heads can force antepenultimate stress in Kiriwina. As Kiriwina does not have any central vowels, only the constraints *NON-HD$_{Ft}$/*a*, *NON-HD$_{Ft}$/*a,e•o* and *NON-HD$_{Ft}$/*a,e•o,i•u* are relevant here. It is important to recall that the *NON-HD$_{Ft}$ constraints favour low sonority over high sonority, in contrast to the *HD$_{Ft}$/*x* constraints.

The constraint *NON-HD$_{Ft}$/*a,e•o* is responsible for forcing the foot to retract from the right edge in words like [(mígi)la]. This constraint assigns a violation to a candidate if a foot non-head has more sonority than a high vowel. To deal with a form like [mígila], *NON-HD$_{Ft}$/*a,e•o* must outrank ALIGNFT-R. Why the constraint *NON-HD$_{Ft}$/*a* is not appropriate in this case will be discussed in the next section.

(43) *Foot retraction*

migila	*NON-HD$_{Ft}$/*a,e•o*	ALIGNFT-R
☞ a. (mígi)la		*
b. mi(gíla)	*!	

Candidate (b) violates *NON-HD$_{Ft}$/*a,e•o* because the foot's non-head syllable [la] contains the high-sonority vowel [a]. In contrast, candidate (a) does not violate this constraint: its syllable [la] does not violate *NON-HD$_{Ft}$/*a,e•o* because it is not contained within a foot, and therefore is not the non-head syllable of a foot.

The constraint *NON-HD$_{Ft}$/*a,e•o* must refer specifically to the non-head syllable of a foot. The only other potentially viable option is for it to refer to 'unstressed syllables': *UNSTRESSED/*a,e•o*. However, this constraint would be equally violated by (a) and (b), so ALIGNFT-R would make the crucial decision, incorrectly favouring (b) over (a).[14]

As a final point, *NON-HD$_{Ft}$/*a,e•o* may force more than one violation of ALIGNFT-R. For example, in [tom(méi)kita) the foot appears two syllables from the end. The reason for this is that [mei] is a heavy syllable, and alternative footings would violate either FTBIN-*μ* or the syllable-structure constraints that promote diphthongs (e.g. ONSET).

(44) *Further foot retraction*

tommeikita	ONSET	*NON-HD$_{Ft}$/*a,e•o*	ALIGNFT-R
☞ a. tom.(méi).ki.ta			**
b. tom.mei.(kí.ta)		*!	
c. tom.me.(í.ki).ta	*!		*

4.3 Conflation of low and mid vowels

Conflation provides evidence that *NON-HD$_{Ft}$/*a,e•o* is active, rather than *NON-HD$_{Ft}$/*a*. *NON-HD$_{Ft}$/*a,e•o* conflates the difference between [a] and [e o] in foot non-heads; in other words, it assigns the same violations to both CV́C{e o} and CV́Ca feet. This conflation is essential in explaining

[14] As it is, the ranking established above predicts that stress should retract to syllables before the antepenult in words with a shape like [CVCiCaCa]. I was unable to find any relevant words in Lawton (1993) and Senft (1986).

why words like [i(dója)] have penultimate stress rather than antepenultimate *[(ído)ja]: antepenultimate stress in this form will not improve the non-head's sonority significantly enough as *[(ído)ja] still has a high-sonority foot non-head, as illustrated in tableau (45).

(45) *Conflation of low and mid vowels*

idoja	*NON-HD$_{Ft}$/*a,e•o*	ALIGNFT-R
a. (ído)ja	*	*!
☞ b. i(dója)	*	

Both candidates equally violate *NON-HD$_{Ft}$/*a,e•o* by having non-high vowels in the foot's non-head. The winner is therefore determined by ALIGNFT-R, with candidate (b) being favoured.

Tableau (45) also shows that *NON-HD$_{Ft}$/*a* is inactive. If it were active, *[(ído)ja] would win, as it would not have [a] in the non-head of a foot. Tableau (46) shows the ranking of *NON-HD$_{Ft}$/*a*.

(46) *NON-HD$_{Ft}$/*a is inactive*

idoja	*NON-HD$_{Ft}$/*a,e•o*	ALIGNFT-R	*NON-HD$_{Ft}$/*a*
a. (ído)ja	*	*!	
☞ b. i(dója)	*		*

If *NON-HD$_{Ft}$/*a* outranked ALIGNFT-R it would incorrectly favour candidate (a) over (b). In other words, tableau (46) makes the point that CVC{e o} and CVCa feet are conflated in Kiriwina: they are treated as equally disharmonic.[15]

4.4 Non-retraction and foot heads

The ranking above accounts for all the other facts of Kiriwina stress. As noted above, stress does not retract to the antepenult when the final vowel is high: e.g. [igibu(lú.i)], [mdo(wáli)], [m(lópu)]. The reason for the lack of retraction is that the feet in these words do not have any non-heads with unacceptably high sonority – i.e. none violate *NON-HD$_{Ft}$/*a,e•o*. Therefore, retraction would be gratuitous, as shown in tableau (47).

(47) *No gratuitous foot retraction*

igibului	*NON-HD$_{Ft}$/*a,e•o*	ALIGNFT-R
☞ a. igibu(lú.i)		
b. igi(búlu)i		*!

[15] The ranking *NON-HD$_{Ft}$/*a,e•o* $\gg$ ALIGNFT-R predicts that words ending in mid vowels will undergo stress retraction; however, there were no such words in the sources. See note 13.

The ranking also accounts for the fact that stress does not retract when the penult contains a non-high vowel and the ultima a low vowel. Both *[(bóna)ra] and [bo(nára)] incur the same violations of *NON-HD$_{\mathrm{Ft}}$/*a,e•o*, so retraction would achieve nothing.

(48) *No gratuitous foot retraction*

bonara	*NON-HD$_{\mathrm{Ft}}$/*a,e•o*	ALIGNFT-R
a. (bóna)ra	*	*!
☞ b. bo(nára)	*	

The words cited above also show why an approach that entirely relies on head-sonority constraints will not work. Head-sonority constraints are only useful when competing candidates differ in the sonority of the stressed syllable. However, there are many cases in Kiriwina where candidates do not differ in head sonority, yet the form with antepenultimate stress wins. For example, the two competitors for /migila/ are [(mígi)la] and *[mi(gíla)]. Both candidates incur exactly the same head-sonority violations, since both have stressed high vowels. Therefore, since the head-sonority constraints do not favour one candidate over the other, the choice of winner should fall to ALIGNFT-R, incorrectly predicting that the penultimate stressed candidate should win. In short, the difference between [(mígi)la] and *[mi(gíla)] lies not in their foot heads, but in the sonority of their foot non-heads, so the *HD$_{\mathrm{Ft}}$/*x* constraints are irrelevant here.

As head sonority does not matter in Kiriwina, all head-sonority constraints that distinguish among [i u e o a] must be inactive. For example, *HD$_{\mathrm{Ft}}$/*ɨ,ə,i•u* must be ranked below ALIGNFT-R, otherwise it would incorrectly favour *[(p^{w}á.ju)ju] over [p^{w}a(jú.ju)] 'sour' if active, and *HD$_{\mathrm{Ft}}$/*ɨ,ə,i•u,e•o* would incorrectly favour *[(mámo)va] over [ma(móva)] 'be alive'.

The remaining relevant *NON-HD$_{\mathrm{Ft}}$/*x* constraints can now be located in the ranking. A way to avoid violations of the non-head constraints is to reduce the size of the foot. For example, *[bona(rá)] avoids violations of *NON-HD$_{\mathrm{Ft}}$/*a,e•o,i•u*, while [bo(nára)] does not. The non-head constraints never force 'degeneration' in Kiriwina (though they do in other languages – de Lacy 2002a: §4.1). Therefore, FTBIN-*μ* must outrank all *NON-HD$_{\mathrm{Ft}}$/*x* constraints; as FTBIN-*μ* favours [bo(nára)] over *[bona(rá)], for example, it effectively blocks *NON-HD$_{\mathrm{Ft}}$/*a,e•o,i•u* from favouring the ungrammatical form.

(49) *Avoiding foot degeneration*

bonara	FTBIN-*μ*	*NON-HD$_{\mathrm{Ft}}$/*a,e•o,i•u*	ALIGNFT-R
☞ a. bo(nára)		*	
b. bona(rá)	*!		
c. bo(ná)ra	*!		*

FtBin-μ must outrank all *Non-Hd$_{\mathrm{Ft}}$/*x* constraints for the same reason – all of them favour degenerate feet over binary ones. For example, if *Non-Hd$_{\mathrm{Ft}}$/*a,e•o* outranked FtBin-μ, it too would incorrectly favour *[bona(rá)] over [bo(nára)], and the same goes for *Non-Hd$_{\mathrm{Ft}}$/*a*.

As a final note, the constraint Trochee must also outrank *Non-Hd$_{\mathrm{Ft}}$/*a,e•o*, otherwise the iambic footed *[mi(gilá)] would win.[16]

To summarise, Kiriwina shows that the sonority of foot non-heads can be decisive in determining stress placement. The rankings established in the preceding sections are summarised in (50).

(50) *Kiriwina: ranking*

FtBin-μ Trochee

*Non-Hd$_{\mathrm{Ft}}$/*a,e•o,i•u* *Non-Hd$_{\mathrm{Ft}}$/*a,e•o* Onset

AlignFt-R

*Hd$_{\mathrm{Ft}}$/*ɨ,ə,i•u* *Hd$_{\mathrm{Ft}}$/*ɨ,ə,i•u,e•o* *Non-Hd$_{\mathrm{Ft}}$/*a*

The ranking expresses the fact that foot form is invariant – since FtBin-μ and Trochee outrank all other constraints, no sonority consideration will force feet to be other than well-formed bimoraic trochees. The diagram also shows the ranking necessary for sonority-driven stress that refers to non-heads of feet: i.e. that some *Non-Hd$_{\mathrm{Ft}}$/*x* constraint (here *Non-Hd$_{\mathrm{Ft}}$/*a,e•o*) outrank some foot-related constraint (here AlignFt-R).

The ranking is similar to Nganasan's, in that the more general constraint outranks the more specific: i.e. *Non-Hd$_{\mathrm{Ft}}$/*a,e•o* outranks *Non-Hd$_{\mathrm{Ft}}$/*a* (i.e. an 'anti-Paninian' ranking, after Prince). Such a ranking allows conflation. As both non-heads with [a] and those with mid vowels incur the same violations of active constraints, the stress system treats both as equally undesirable, thus conflating the difference between the two. Of course, this point about conflation rests on the claim that foot non-heads can distinguish between low and mid vowels for stress purposes. Evidence for this claim is found in Harar Oromo, where the stress system aims to avoid feet with [a] as non-heads, but tolerates non-heads with mid vowels (Owens 1985, de Lacy 2002a: §4.2.2).

[16] The relation of stress to morphological boundaries in Kiriwina will not be discussed in detail here. Lawton (1993: 45) reports that stress always falls on the penult if a morpheme boundary appears in the last three syllables of a word (compare [(lámi)la] 'outrigger log' with [la-(míla)] 'I have become something', and [katu-sa(wási)la] 'clear throat' with [wa(sí-la)] 'its obligation'). Morpheme boundaries before the antepenult are irrelevant (e.g. [i-(búku)la] 'it bore in clusters'). This fact no doubt follows from conditions on morpheme–PrWd alignment, which fall beyond the scope of the present paper (see de Lacy 2002a: §4.2.1.5 for discussion).

4.5 Fixed ranking and conflation in foot non-heads

While the Stringency Hierarchy approach can produce Kiriwina'a conflation, the fixed ranking approach faces significant challenges. For the reader's convenience, the set of *NON-HD$_{Ft}$/x constraints is repeated in (51).

(51) *Foot non-head sonority constraints* (Kenstowicz 1997)

*NON-HD$_{Ft}$/a ≫ *NON-HD$_{Ft}$/e,o ≫ *NON-HD$_{Ft}$/i,u ≫ *NON-HD$_{Ft}$/ə ≫ *NON-HD$_{Ft}$/ɨ

Following the same argumentation as above, *NON-HD$_{Ft}$/e,o must outrank ALIGNFT-R. Due to the fixed ranking, *NON-HD$_{Ft}$/a therefore also outranks ALIGNFT-R. This ranking explains why there is stress retraction in [(mígi)la]. However, because *NON-HD$_{Ft}$/*a* is active, stress is incorrectly predicted to retract in [i(dója)]:

(52) *Fixed ranking prevents conflation of non-heads*

idoja	*NON-HD$_{Ft}$/a	*NON-HD$_{Ft}$/e,o	ALIGNFT-R
☞ a. (ído)ja		*	*
b. i(dója)	*!		

The problem encountered here follows from the generalisation in (27): a set of constraints in a fixed ranking does not allow conflation of a set of marked categories alone. In terms of foot non-heads, the sonority levels 'a' and 'e,o' are marked. Therefore, it is not possible to conflate them without also conflating them with all other less marked categories (i.e. high vowels, in this case).

4.5.1 *Complementary constraints.* However, the preceding paragraphs have not yet shown that the fixed ranking theory fails to deal with Kiriwina's stress system. In §3.5.2, the importance of 'complementary' constraints in conflation was identified: whereas the *HD$_{Ft}$/x constraints failed to conflate unmarked categories in Nganasan (§3.5.1), the $^*\breve{\sigma}/x$ constraints were shown to be able to produce such conflation (§3.5.2). The reason for the success of the $^*\breve{\sigma}/x$ constraints in Nganasan is that they effectively 'reverse' the markedness of the sonority scale: for the $^*\breve{\sigma}$ constraints, high peripheral and central vowels are the least marked elements, and therefore can be conflated.

However, it is not ultimately possible to employ an analogous strategy to deal with Kiriwina. Doing so would require a set of constraints that complements the *NON-HD$_{Ft}$/x constraints: i.e. $^*\xi$/ɨ ≫ $^*\xi$/ə ≫ $^*\xi$/i,u ≫ $^*\xi$/e,o ≫ $^*\xi$/a, where ξ refers to both foot heads and unfooted syllables.

Even a cursory glance at such an approach would suggest that it is doomed to failure, and it surely is. However, it would be remiss to fail to mention it, and give it a fair hearing, as it is directly analogous to the potential alternative theory for Nganasan.

With the ranking *ξ/i,u ≫ ALIGNFT-R, the correct result would be achieved, as shown in the tableaux in (53).

(53) *Complementary constraints produce conflation*

a.

idoja	*ξ/i,u	ALIGNFT-R	*ξ/e,o	*ξ/a
☞ i. i(dója)	*		*	
ii. (ído)ja	*	*!		*

b.

migila	*ξ/i,u	ALIGNFT-R	*ξ/e,o	*ξ/a
i. mi(gíla)	**!			
☞ ii. (mígi)la	*	*		*

In (53a), *ξ/i,u is violated equally by the candidates: candidate (i) has an [i] in an unfooted syllable and candidate (ii) has a [i] in a foot head. This equal violation allows ALIGNFT-R to make the crucial decision, preferring a right-aligned foot. In (53b), *ξ/i,u is crucially violated twice by candidate (i): once for the unfooted [i] and once for the [i] in the foot head. In contrast, candidate (ii) violates *ξ/i,u only once – by the foot head's [i].

However, this approach cannot be correct, because the *ξ/*x* constraints cannot exist for typological reasons. Allowing constraints to refer to both unstressed syllables and foot heads in the same way makes incorrect predictions for vowel reduction. The *ξ/*x* constraints favour unstressed unfooted syllables with high sonority; they therefore contradict the effect of the *UNSTRESSED/*x* constraints, which favour low-sonority vowels in unstressed syllables. This predicts the unattested situation where all unstressed syllables neutralise to the most sonorous vowel – [a].[17] In addition, the *ξ/*x* constraints refer to a non-unified structural category – foot heads and unfooted syllables. They therefore predict that the two classes could undergo the same sonority-based processes in some language (e.g. high vowels could be banned in both stressed and unfooted syllables); there is no evidence for such a link. For this reason, a structurally complementary approach to foot non-head conflation is inadequate.

Finally, it is not possible to divide the *ξ/*x* constraints into two: i.e. into series of *HD_{Ft}/*x* constraints and *UNFOOTED/*x* constraints. For /idoja/, *HD_{Ft}/i,u would have to outrank *UNFOOTED/i,u to ensure that [i(dója)] beat *[(ído)ja]; in contrast, *UNFOOTED/i,u would have to outrank *HD_{Ft}/i,u in order for [a(púku)] to beat *[(ápu)ku].

[17] Crosswhite's (1999) survey of vowel reduction does not identify any case where *all* unstressed syllables neutralise to a highly sonorous vowel (e.g. [a]) nor does her theory predict it. In contrast, her work identifies languages in which *some* unstressed syllables (usually low and mid syllables) neutralise to [a], but others reduce to [ə] or raise to [i u].

4.5.2 *Other constraints.* The discussion above has shown that *NON-HD$_{Ft}$/*x* cannot produce conflation in foot non-head position, and 'complementary constraints' cannot help resolve this problem. Is it possible that some other higher-ranked constraint(s) C could do so?

Following the same lines as in §3.5.4, C would have to specifically target foot non-heads in penultimate position: e.g. *PENULTNON-HD/e,o (perhaps as part of a *PENULTNON-HD/*x* series). If *PENULTNON-HD/e,o outranked NON-HD$_{Ft}$/a, the right result would be obtained for /idoja/: *[(ído)ja] would violate *PENULTNON-HD/e,o, while [i(dója)] would only violate the lower-ranked *NON-HD$_{Ft}$/e,o.

Of course, *PENULTNON-HD/*x* constraints are a local solution: they account for conflation in Kiriwina, but not necessarily in other languages with non-head conflation, or for other phenomena. In addition, there are the same reasons to doubt the existence of the *PENULTNON-HD/*x* constraints as for the *ANTEPEN/*x* constraints in §3.5.4. The constraints make unattested typological predictions: they predict a language in which unstressed footed syllables become less sonorous (i.e. reduce), but only in penultimate position (i.e. if *PENULTNON-HD/*x* ≫ IDENT[F] ≫ *NON-HD$_{Ft}$/*x*). This particular type of position-sensitive (as compared to constituent-sensitive) vowel reduction has not been reported.[18]

To summarise, *NON-HD$_{Ft}$/*x* constraints in a fixed ranking cannot produce the Kiriwina stress system – or more generally conflation of 'marked' elements in foot non-head position for stress. It is not possible to invoke other constraints to help either: such constraints (i.e. *ξ/x and *PENULTNON-HD/*x*) make unattested predictions.

4.5.3 *Sonority distance.* An alternative to the present approach that requires attention is one based on sonority distance rather than on reference to foot non-heads. Constraints requiring that two nearby segments have a certain degree of sonority difference between adjacent segments have been proposed in a number of previous works (Selkirk 1982, Davis 1998, Gouskova 2002 and many others). It might seem a natural extension to have constraints that refer to sonority distance between heads of feet and non-heads, and use these for Kiriwina. Closer examination reveals difficulties with such an approach, however.

Sonority distance is often tied in with syllable-contact restrictions. In a number of cases, adjacent heterosyllabic consonants are banned from rising in sonority (see references above): e.g.*[t.n], cf. [n.t.]. In a similar

[18] See de Lacy (2002a: ch. 4) and references cited therein for examples of vowel reduction in particular constituents (especially non-heads of feet). Nevertheless, there are some cases of position-sensitive vowel reduction: Russian limits vowel reduction in absolute word-initial position (Crosswhite 1999), and many dialects of English allow more contrasts in PrWd-final syllables than in others (e.g. [ə i oʊ] final unstressed *vs.* [ə] non-final unstressed). However, such cases where lack of reduction focuses on domain edges seems to have a different character than the type of unattested position-sensitive reduction discussed here. It would seem to be more amenable to a positional faithfulness account (Beckman 1997) than an approach based on position-specific markedness constraints.

way, there could be constraints that ban a sonority rise from the head of a foot to the non-head. With this view, the Kiriwina stress 'retraction' in [(lámi)la] could be seen as the avoidance of a sonority rise in the competitor *[la(míla)]. The same could be said for favouring [(mígi)la] – with level sonority – over *[mi(gíla)], with rising sonority. To further refine this approach, it is not all rises that are avoided, but rather a two-step rise: i.e. [C{í ú}Ca], but not [C{é ó} Ca] or [C{í ú}C{e o}]. This condition is needed to explain why [tomto(móta)], with a rising-sonority foot, is not beaten by the level-sonority foot *[tom(tómo)ta].

For Kiriwina, the sonority-rise approach achieves the right results. The one piece of evidence that would distinguish the *NON-HD$_{\text{Ft}}$ approach from the sonority-rise one is a word with a penult high vowel and a final mid vowel. The *NON-HD$_{\text{Ft}}$ approach predicts antepenult stress in such a case, as *NON-HD$_{\text{Ft}}$/*a,e•o* would force retraction, while the sonority-rise approach predicts penult stress, as the sonority distance from high to mid vowels is only one step. Unfortunately, such words do not exist in Kiriwina (see note 14). Generally speaking, though, this is the sort of situation that would provide crucial evidence to distinguish the two approaches, at least for sonority-driven stress.

While no such case has yet been identified, it is possible to turn to other phonological phenomena to help make a choice. In Optimality Theory, the same markedness constraint can provoke a variety of phenomena (Pater 1996). For example, *NON-HD$_{\text{Ft}}$/*a,e•o* can not only influence footing, but can also force vowel reduction (see de Lacy 2002a: ch. 4 for detailed discussion; also Crosswhite 1999). If *NON-HD$_{\text{Ft}}$/*a,e•o* and footing constraints (e.g. ALIGNFT-R) outrank faithfulness constraints, the preferred response will be to reduce the vowel in the non-head foot: e.g. /palika/→ [pa(líki)], *[(páli)ka]. The *NON-HD$_{\text{Ft}}$/*x* constraints make correct predictions for neutralisation: they predict that high-sonority elements in foot non-heads can neutralise, as found in Dutch, Faetar and other languages (de Lacy 2002a: ch. 4).

In contrast, the sonority-rise approach makes apparently unattested predictions for vowel reduction. With a constraint that bans a rise of two steps, as needed for Kiriwina, /a/ in the non-head of a foot would reduce only when the head of the foot contained a high vowel: e.g. /pika/ →[(píkə)], cf. /poka/→[(póka)], *[(pókə)]. I am unaware of such cases of vowel neutralisation that are conditional on the sonority of the foot head.

To summarise, while a 'anti-sonority rise' approach potentially provides an alternative solution for Kiriwina, it does not make the same predictions as the *NON-HD$_{\text{Ft}}$/*x* approach. Furthermore, the anti-sonority-rise approach makes unattested typological predictions in vowel reduction, unlike the *NON-HD$_{\text{Ft}}$/*x* approach. An analogous discussion for tone-driven stress can be found in de Lacy (1999: §4.2).

As a final note, while a sonority-distance approach does not ultimately work in this context, there is no doubt that sonority-distance effects do exist for adjacent segments. In fact, a stringency approach to sonority distance may well prove fruitful, though such an exploration is beyond the scope of the present work.

4.6 Summary

To summarise, this section has argued that the Stringency Hierarchy and fixed ranking theories differ in terms of conflation in foot non-heads. The Stringency Hierarchy constraints can produce conflation of marked categories alone in foot non-heads (i.e. mid and low vowels in Kiriwina). In contrast, the fixed ranking theory cannot, given standard assumptions about CON. The *NON-HD/x constraints in a fixed ranking do not allow 'unmarked' categories to conflate, and no other constraints can intervene to do so. In more general terms, for a fixed ranking approach to produce all possible single conflations of some hierarchy $H = \alpha \rangle \beta \rangle \dots \rangle \gamma$ in some position P, there must be two sets of constraints: $*P/\alpha \gg *P/\beta \gg \dots \gg *P/\gamma$ and $*P'/\gamma \gg \dots \gg *P'/\beta \gg *P'/\alpha$, where P and P′ refer to structurally complementary positions. However, if there is a set of constraints *P/x but no constraint *P′/x (just as there is a set of *NON-HD$_{Ft}$/x constraints, but no *ξ/x constraints), then conflation of marked categories alone with respect to P is not possible.

5 Typology

The aim of this section is to show that the typological predictions of the Stringency Hierarchy constraints are borne out.

A typology of systems with sonority-driven foot head placement is given in Table I. Building on de Lacy (1997, 2002a) and Prince (1999), almost every possible contiguous conflation in stress–sonority interaction is attested. Categories are marked as conflated if they are grouped inside the same box. For example, the mid and low vowels are conflated in Asheninca, but the central and high vowels are not. Note that the table uses '*ə*' to stand for any central vowel (e.g. Asheninca has [ɨ], not schwa) due to the rarity of contrast between /ə/ and /ɨ/.

The only gap is a language that conflates [ə́] and [í ú] but distinguishes mid from low vowels. In such a grammar, stress would be much as in Nganasan, except that it would retract from a mid vowel penult to a low vowel, I assume that this gap is accidental. Note that Table I provides evidence for the vowel-sonority hierarchy in (1) – for every category in (1), there is some language that distinguishes that category from some other category.

An analogous table for non-head sonority conflation is not provided here due to the fact that fewer cases have been identified compared with head sonority conflation. Three cases are (i) Kiriwina, which has conflation of low and mid peripheral vowels *vs.* high vowels, (ii) Harar Oromo, which avoids [2] in foot non-heads, and conflates mid peripheral and high vowels (Owens 1985, de Lacy 2002a: ch. 4) and (iii) Mari, which

categories				languages
ə	*i•u*	*e•o*	*a*	Kobon (Davies 1981)
ə	*i•u*	*e•o*	*a*	Gujarati (de Lacy 2002a: ch. 3)
ə	*i•u*	*e•o*	*a*	Asheninca (Payne 1990)
ə	*i•u*	*e•o*	*a*	Yil (Martens & Tuominen 1977)
ə	*i•u*	*e•o*	*a*	—
ə	*i•u*	*e•o*	*a*	Nganasan (§ 3)
ə	*i•u*	*e•o*	*a*	Kara (Schlie & Schlie 1993, de Lacy 1997)
ə	*i•u*	*e•o*	*a*	*all vowels are treated the same*

Table I
Head-sonority conflation typology.

avoids full vowels in foot non-head position (of unbounded feet) (Kenstowicz 1997). For foot non-heads and the tonal hierarchy, see de Lacy (2002b).

The table above identifies the language-specific side of the Stringency Hierarchy constraints' predictions. However, there are two universal aspects: the constraints predict 'universal conflations' – categories that will never be distinguished for stress, and conflation types that are impossible.

5.1 Universal conflations

An example of a universal conflation is the distinction between [í] and [ú]. No Stringency Hierarchy constraint proposed here favours one over the other. Along with the crucial assumption that no other constraint in Con distinguishes the two types, then for every possible ranking, no constraint that distinguishes [í] from [ú] is active; therefore, [í] and [ú] are conflated.

This particular prediction is borne out by the fact that no stress system treats these two categories differently. There is no language, for example, where stress seeks out the leftmost [i], avoiding a [u] closer to the default stress position (or *vice versa*). Similarly, no language treats [e] as distinct from [o] for stress purposes, so the same explanation holds: there is no constraint that favours [é] over [ó], or *vice versa*. In short, two categories *x* and *y* are distinct if and only if some constraint favours one over the other, so if two categories are never distinct, there can be no such constraint.

5.2 Impossible conflations

Missing in Table I is a language that conflates non-contiguous categories. For example, there is no language that treats high vowels and low vowels in the same way and distinguishes both types from mid vowels for stress placement. To be more precise, there is no language like the one described in (54).

(54) *Non-contiguous conflation* (*predicted to be impossible*)

a. *Stress falls on the leftmost high or low vowel* [i u a]
[píta], [píte], [píti]
[petí], [petá]
[páta], [páte], [páti]

b. *Otherwise it falls on the leftmost vowel*
[péte]

In this system, stress avoids a mid vowel without also avoiding a low vowel. In effect, [a] and high vowels have been conflated into a single category.

The reason why the present theory prevents such conflation relates to hierarchies and the fact that non-contiguous conflation requires a reversal in hierarchical relations. If stess avoids mid vowels for high vowels, there must be some constraint that favours stressed high vowels over stressed mid vowels. The present theory has no such constraint; the only constraint that bans stressed mid vowels also bans stressed high vowels: i.e. *HD$_{\text{Ft}}$/*ɨ,ə,i·u,e·o*. In short, such a language would require a reversal in the relative ranking of mid and high vowels.

From a conflation perspective, for [a] and high vowels to be conflated no relevant active constraint can assign them different violations. However, for mid vowels to be distinct from both [á] and [í ú], some set of constraints must assign mid vowels unique violations. In the present theory, both *HD$_{\text{Ft}}$/*ɨ,ə,i·u,e·o* and *HD$_{\text{Ft}}$/*ɨ,ə,i·u* would have to be active to distinguish mid vowels from the others. Both of these constraints distinguish high vowels from [a], though, preventing their conflation.

5.3 Which constraints cannot exist?

It is important to note that the predictions of the present theory not only rest on the existence of its constraints, but on the claim that CON contains no antagonistic constraints – i.e. constraints that impose the opposite harmonic relations between categories. For example, the constraint *HD$_{\text{Ft}}$/midV cannot exist; this constraint assigns violations to mid vowels in stressed syllables, thereby favouring stressed high and low vowels over stressed mid vowels (cf. Crosswhite's LICENSE-NONPERIPHERAL/STRESS; 1999: §2.0.2). Such a constraint allows for a non-contiguous conflation, thereby subverting the present theory's effects. The fact that such a conflation does not happen indicates the CON does not contain such a constraint, or never allows it to be ranked in such a way that it can affect the outcome of stress assignment.

6 Conclusions

The aim of this article was to present a way to express markedness hierarchies in Optimality Theory while allowing languages to ignore (i.e. 'conflate') markedness distinctions. In line with prince (1997 *et seq.*), the leading ideas behind this approach are that hierarchy-referring constraints are (a) freely rankable and (b) refer to a contiguous range of the hierarchy, starting with the most marked element. These ideas were implemented formally by proposing a connection between hierarchies and features: hierarchies are expressed as multivalued phonological features, with each value corresponding to an element on the hierarchy. The features were then converted into constraints. In the case of the sonority hierarchy, the constraints combined structural positions with the [sonority] feature.

For sonority and foot heads and non-heads, the result was the constraints given in (3). §§3 and 4 presented evidence that conflation occurs in natural language. While Nganasan stress is sensitive to certain sonority distinctions, it ignores others. So, stress can deviate from penultimate position for highly sonorous vowels (e.g. [sóletu]). However, it does not avoid the lower-sonority central vowels for higher-sonority high peripheral vowels: e.g. [cintéɟi], *[cíntəɟi]. This type of category conflation was shown to be easily expressed with the Stringency Hierarchy constraints: the constraint that distinguished high peripheral from central vowels $*\text{HD}_{\text{Ft}}/ɨ{\cdot}ə$ was ranked below the foot-alignment constraint, rendering it inactive.

The fixed ranking theory was also shown to produce many cases of conflation. However, for the relation between foot heads and sonority, it was shown to be unable to produce two separate sets of hierarchy conflations in the same stress system, as found in Nganasan. In addition, for foot non-heads, the fixed ranking approach was shown to be unable to produce conflation of marked categories in certain structural positions, as in Kiriwina's conflation of mid and high vowels in foot non-heads (§4).

While this paper focused on sonority in foot heads and non-heads, the Stringency Hierarchy approach is equally relevant for other hierarchies and other structural positions, and makes similar predictions. For example, the head-tone constraints in de Lacy (2002b) can be expressed as $*\text{HD}_{\text{Ft}}/\text{L}$, $*\text{HD}_{\text{Ft}}/\{\text{L,M}\}$, and $*\text{HD}_{\text{Ft}}/\{\text{L,M,H}\}$, predicting systems in which stress conflates low- and mid-toned foot heads. The proposal even applies to hierarchies that do not combine with a structural position. For example, a place of articulation hierarchy with the form dorsal > labial > coronal > glottal (Lombardi 2001) can be expressed as *{dorsal}, *{dorsal, labial}, *{dorsal,labial,coronal} and *{dorsal, labial,coronal,glottal}, also predicting conflation effects (de Lacy 2002a: chs. 6–8). Syntactic hierarchies can be treated in a similar manner. Adopting the approach of Aissen (1999), the combination of the position 'Subject' and person hierarchy 1st ⟩ 2nd ⟩ 3rd is expressed in Stringency Hierarchy constraints as *Subj/3rd, *Subj/3rd·2nd, and *Subj/3rd·2nd·1st, instead of the fixed ranking *Subj/3rd ≫ *Subj/2nd ≫ *Subj/1st. For further details on the stringency Hierarchy approach to other scales, see de Lacy (2002a, to appear).

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